LNHS

THE LONDON NATURALIST

Journal of the
LONDON NATURAL HISTORY SOCIETY

No. 82 2003

LONDON NATURAL HISTORY SOCIETY

The Society welcomes new members, both beginners and experts. Its recording area (the London Area) lies within a 20-mile (32-km) radius of St Paul's Cathedral and here most of its activities take place. Although much covered with bricks and mortar, it is an exciting region with an astonishing variety of flora and fauna. The Society comprises Sections whose meetings are open to all members without formality. For those interested in arachnology, archaeology, botany, conchology, conservation, ecology, entomology, geology, herpetology, mammalogy, ornithology, palaeontology, or rambling, there is a Section ready to help.

Publications

The London Naturalist, published annually, contains papers on the natural history and archaeology of the London Area and beyond, including records of plants and animals.

The *London Bird Report,* also published annually, contains the bird records for the London Area for each year, as well as papers on various aspects of ornithology.

Bulletins of news items, including the Society's *Newsletter* and the *Ornithological Bulletin,* are sent to members throughout the year.

Indoor meetings

These are held in most weeks throughout the year, with lectures, discussions, colour slides and films on all aspects of natural history.

Field meetings

Led by experts to visit interesting localities, both within and outside our Area. These excursions are very popular with beginners wishing to increase their knowledge, and enable members to get to know one another.

Library

A large selection of books and journals on most aspects of natural history is available for loan or consultation by members free of charge.

Reading circles

Many important natural history journals are circulated by the Sections at a fraction of the cost of subscribing direct.

SUBSCRIPTIONS

ORDINARY MEMBERS	£20.00
JUNIOR MEMBERS	£5.00
SENIOR MEMBERS	£16.00
FAMILY MEMBERS	£4.00
CORPORATE SUBSCRIBERS	£20.00

Junior membership is for persons under 18, or under 25 and receiving full-time education, and senior membership is for persons over 65 who have been continuous members of the Society for ten complete years. All except family members receive one free copy of *The London Naturalist* and the *London Bird Report* each year. Cheques and postal orders, payable to the London Natural History Society, should be addressed to:

The Assistant Treasurer, LNHS,
Robin Blades,
32 Ashfield Road, London N14 7JY

THE LONDON NATURALIST

Further copies of this issue of *The London Naturalist* may be obtained (price £6 plus £1 postage and packing in the UK and the Republic of Ireland) from Catherine Schmitt, 4 Falkland Avenue, London N3 1QR. Back numbers of most recent issues of both *The London Naturalist* and *London Bird Report* are also available from the same address. Cheques should be made payable to the London Natural History Society.

Nat. size

c. × 6

Top: A female *Argiope bruennichi* in its characteristic position in the centre of its web. The web is decorated with stabilimenta above and below the centre of the orb, while the web itself is usually near the ground. This may be because the spider preys on grasshoppers. During 2002, *A. bruennichi* was seen at several sites in and around London for the first time, including on Hampstead Heath in an area where tall herbs have been allowed to grow without being mown. *Photo: J. E. D. Milner*

Bottom: A female *Araneus alsine*, the strawberry spider, Bookham Common, 14.ix.2002. This Nationally Scarce (Notable B) species is widespread in Britain but uncommon and local, with few recent records. It is usually found on grasses and other low vegetation in damp, sheltered woodland clearings. *Photo: I. S. Menzies*

Records of both these species will be welcome and should be sent to the Society's Arachnida Recorder — see page 4.

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LONDON NATURAL HISTORY SOCIETY

Founded 1858

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30 Arlington Gardens, London W4 4EY

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Editor, *London Bird Report:* A. Self, 16 Harp Island Close, London NW10 0DF.

Editor, *Newsletter:* G. Lyall, 15 The Esplanade West, Sunderland SR2 7BG.

Editor, *Ornithological Bulletin:* N. Tanner, 11 Collins House, Newby Place, London E14 0AX.

Elected Members of Council: N. Anderson, M. Burgess, Ms A. Chipchase, A. J. Leppard, Miss F. J. Turtle.

Representative Members of Council: BOOKHAM COMMON SURVEY — Dr I. S. Menzies; BOTANY — R. A. Blades; ECOLOGY AND ENTOMOLOGY — Mrs C. M. Schmitt; HAMPSTEAD HEATH SURVEY — Dr C. Bowlt; ORNITHOLOGY — Miss N. A. Duckworth.

† Deceased April 2003.

The Society's Recorders

Botany

Flowering plants and vascular cryptogams: R. M. Burton, MA, FLS, Sparepenny Cottage, Sparepenny Lane, Eynsford, Kent DA4 0JJ (01322 863216).

Lichens: Ms A. J. H. Waterfield, B.SC., 29 Gloucester Crescent, London NW1 7DL (020-7267 8060).

Ecology and Entomology

Mammals: C. Herbert, 67a Ridgeway Avenue, East Barnet, Hertfordshire EN4 8TL (020-8440 6314).

Reptiles and amphibians: T. E. S. Langton, B.SC., 12 Millfield Lane, London N6 6RA (01986 784518).

Fishes: Dr Ruth Kirk, School of Life Sciences, Faculty of Science, Kingston University, Penrhyn Road, Kingston upon Thames, Surrey KT1 2EE (020-8547 2000 ext. 62732; home 020-8401 6766).

Arachnida: J. E. D. Milner, B.SC., 80 Weston Park, London N8 9TB (020-8341 2158).

Coleoptera (Carabidae and Coccinellidae): P. R. Mabbott, B.SC., 49 Endowood Road, Sheffield S7 2LY (0114-201 4504).

Coleoptera (Lucanidae and Buprestidae): Dr D. S. Hackett, FRES, 3 Bryanstone Road, London N8 8TN (020-8292 6134).

Coleoptera (families not otherwise listed): M. V. L. Barclay, 47 Tynemouth Street, London SW6 2QS (020-7371 9095).

Lepidoptera (butterflies): L. R. Williams, 34 Christchurch Avenue, Kenton, Harrow, Middlesex HA3 8NJ (020-8907 4428).

Lepidoptera (moths), Syrphidae, and invertebrates not otherwise listed: C. W. Plant, B.SC., FRES, 14 West Road, Bishops Stortford, Hertfordshire CM23 3QP (01279 507697).

Orthoptera: Miss S. L. Bain, 232 Brecknock Road, London N19 5BQ (020-7609 0430).

Hymenoptera Aculeata: R. W. J. Uffen, 4 Mardley Avenue, Welwyn, Hertfordshire AL6 0UD (01438 714968).

Heteroptera: Vacant.

Odonata: Neil Anderson, B.SC., 52 Beechwood Avenue, Greenford, Middlesex UB6 9UB (020-8578 2464).

Plant galls, Isopoda and Myriapoda: K. Hill, BA, FLS, 93 Elmhurst Drive, Hornchurch, Essex RM11 1NZ (01708 456652).

Mollusca: Vacant.

Records may be sent to the appropriate recorder (where shown) or to Colin Plant who will distribute to each recorder the relevant data from a mixed set of records.

Geology

c/o R. E. Butler, B.SC., FGS, 205 Barnett Wood Lane, Ashtead, Surrey KT21 2DF (01372 274103).

Ornithology

Inner London: D. McKenzie, 26 Cuthbert House, Hall Place, London W2 1LT.

Hertfordshire: A. D. D. Wilson, 7 Douglas House, Davison Drive, Cheshunt, Hertfordshire EN8 0SZ.

Buckinghamshire: A. V. Moon, 46 Highfield Way, Rickmansworth, Hertfordshire WD3 2PR.

Kent and Lower Thames (London Bridge to Tilbury): D. Miller, 65 Whitemill Road, Crayford, Kent DA1 4AB.

Surrey and Upper Thames (London Bridge to Staines): S. J. Spooner, 32 Berkeley Drive, West Molesey, Surrey KT8 1RA.

Middlesex: S. Connor, 21 Salisbury Road, Enfield Lock, Enfield, Middlesex EN3 6HG.

Essex: S. R. Harris, 155 Downsell Road, London E15 2BS.

Requests for information should be made to the appropriate recorder.

Contents

Report of the Society for the year ending 30 June 2002

Approved at the Annual General Meeting on 11 December 2002

We must sadly record the death of our president David McClintock , MBE in November 2001. David, a national figure, greatly contributed to the natural history movement in this country which is much the poorer for his passing. In September 2001 Ted Bangerter FLS (a past president and honorary vice-president) died in New Zealand; it was only in May 2001 that Council had sent their congratulations to him on his reaching his ninetieth birthday — his gracious acknowledgement and subsequent death would have reminded members of long-standing of the tremendous work he did for the natural history movement, and botany in particular, during the middle of the twentieth century; truly the end of an era. Obituaries to David and Ted will be published in *The London Naturalist.*

The sudden death of our membership secretary, Ruth Day (a past president), created not only great sorrow but much extra work for the other senior officers; an obituary to Ruth will also be published in *The London Naturalist.* Her contribution to the running of the Society was immense; indeed many hours have been spent seeking to spread her workload; ultimately this will be achieved but it will be difficult to replace the enthusiasm and energy she expended in furthering the cause of the Society and nature conservation.

We must also record the deaths of David Burnett and Daphne Jones.

At a time when concern for our environment is constantly mentioned in the media it can do nothing but good for all to be reminded of the objectives of the Society:

> '. . . the study of natural history . . . the promotion of scientific investigations, nature conservation and the publication . . . of . . . papers . . . .'

From the contents of subsequent paragraphs it is clear that your Society is meeting the objectives which it set itself in the middle of the nineteenth century. Members have been studying and recording their findings in nearly all the relevant disciplines — our two permanent research centres at Bookham Common and Hampstead Heath continue to be supported both by members and helpful outside agencies. Your Society is an active Partner in the London Biodiversity Partnership and evidence was given on your behalf to the Mayor of London's Draft Biodiversity Strategy, *Connecting With London's Nature.* Our journals continue to be published and work has continued apace on the long-awaited *The breeding birds of the London Area.*

To continue with such important objectives your Society needs both an increase in membership and a sound financial base. Recruitment of new members, particularly those able to give some of their time to the running of the Society's activities, is vital if we are to continue to function successfully. Hard-working and willing members are the bedrock of the Society and an increase in the general membership and in those prepared to participate more fully, would strengthen the Society's position. During the past year, our financial reserves have been eroded by a declining Stock Market; whilst in the long term our resources are adequate, we need to be able to operate as economically as possible, particularly during this period of turbulence in the financial markets.

Publications and journals

The London Naturalist No. 80 was published in December 2001; as a supplement, the second volume of 'The Natural History of Buckingham Palace Garden' was issued. Your Council has decided that a leather-bound copy of both volumes should be presented to Her Majesty the Queen on the

occasion of her Golden Jubilee. It is also proposed to present bound copies to Mark Lane (head gardener at Buckingham Palace) and to Colin Plant (editor) to offer our thanks for their work in producing and publishing the results of the survey.

Production of the *London Bird Report* continues to be delayed; your Council will be considering what additional help can be given to the hard working *LBR* team to try to bring the publication back on to a regular basis.

Whilst work on the publication of *The breeding birds of the London Area* has progressed well, the illness (and subsequent withdrawal from the project) of Wyn Wheeler leaves the production of a history of the Society in real doubt.

The *Newsletter* and the *Ornithological Bulletin* continue to be enjoyed by members.

Research stations

Hampstead Heath Survey. The regular monthly meetings have attracted between twelve and eighteen workers but a permanent secretary is required. The flora survey is almost complete but the hold-up in getting data transferred to a suitable computer format to produce distribution maps has been tiresome.

In March 2002 Colin Bowlt held a field-class at our Centre for evening students on the Conservation and Ecology Course, Birkbeck College, and our training days are now well established with encouraging attendances.

Bookham Common. Whilst the effects of the foot-and-mouth crisis were less than anticipated, more significant (though possibly transitory) were the effects of the very wet spring. The botantists in the final year of their major plant survey are surprisingly encountering many new species, some of which are common in Surrey but previously unrecorded on the Common. The entomologists too have had an outstanding year with many new discoveries of notable beetle species.

Attendance at regular meetings is satisfactory but the average age of the workers is too high and the involvement of younger members is essential to the long-term future of the project. A greater concern is the recent alteration in the responsibilities of The National Trust warden, Ian Swinney, who has contributed substantially and enthusiastically to our activities. It may be that he will not be able to devote so much time in helping us in the future — your Council will be making representations to senior levels of The National Trust.

Sections

Botany. The interesting and varied programme both indoors and outdoor was not too badly affected by foot-and-mouth disease. Members have supported out work for protecting mistletoe and black poplar as proposed in the London Biodiversity Action Plans. Our lichen recorder, Amanda Waterfield, has managed to get lichens into the Churchyards and Cemeteries Habitat Action Plan.

Ecology and Entomology. The Section again arranged our participation at the Annual Exhibition of the Amateur Entomologists' Society.

Ornithology. Members supported the first Lee Valley Bird Fair and the Section will in the future assume responsibility for our participation in what is to be an annual event.

Fuller reports on the activities of the research stations and Sections are published in *The London Naturalist* each year.

Library

The generous gift to the Library of Elizabeth de Quidt's books and videos is much appreciated.

Redevelopment of the Imperial College Library has continued and some space previously allocated to us has been lost. Thanks to the efforts of Linda Dorrington, Life Sciences Librarian, extra shelving has been provided but this may not be permanent and it may be necessary to reduce the size of our Library.

The changes have caused much extra work for our librarian, Linda Hewitt, and members should be grateful to her for the work she does for the Society, much of which is unseen and consequently unappreciated: as ever the staff of the Imperial College have been very helpful to us.

Conservation

In September 2001 the Mayor of London published his Draft Biodiversity Strategy, *Connecting With London's Nature*. As a requirement of the Greater London Authority Act 1999, this is the first regional biodiversity strategy with a statutory basis. The document therefore has great potential significance for improving wildlife protection in London. Most of its proposals, if carried forward after consultation, would be implemented through the London Biodiversity Action Plan (LBAP) process. Many members responded to the questionnaire that was included with the Draft Strategy and a joint response was submitted on behalf of the Society. The Conservation Officer was called to give evidence as an expert witness before a 'close scrutiny panel' of the GLA. The resulting Biodiversity Strategy for London is awaited with interest.

In January 2002 the London Biodiversity Partnership (of which the Society is an active Partner) published a second round of action plans as part of the unfolding LBAP. These new plans cover acid grassland, the tidal Thames, canals, churchyards and cemeteries, private gardens and parks, squares, and amenity grassland. There are also two new species action plans covering reptiles and the native black poplar where the Society is the 'lead partner'. Members of our Society are involved in carrying forward elements of all these plans.

Other matters

Work on the setting up of the Biological Records Centre for London has continued and your Society will be seeking to make as constructive a contribution as possible bearing in mind that the Society is a voluntary organization.

We were partners with the RSPB and the London Wildlife Trust in the survey arranged through the London Biodiversity Partnership to investigate the cause of the decline of the house sparrow. Your Society awarded a grant of £500 towards the costs of this survey.

It has been a difficult year for many officers, particularly the Treasurer, Secretary and Librarian: all members should be grateful to them. It can be seen from the scope of this report that much good work is being done but more could be achieved if other members would come forward to help those officers presently overworked.

Members of Council (the Trustees), 1 July 2001–30 June 2002

N. Anderson
E. B. Bangerter, deceased September 2001
A. J. Barrett* (Secretary)
K. F. Betton
D. Bevan
R. A. Blades*
Dr C. Bowlt (Chairman)
Miss E. P. Brown
M. Burgess
R. M. Burton*
R. E. Butler
Miss A. Chipchase
Dr P. F. S. Cornelius
Miss R. Day, deceased March 2002
Miss N. A. Duckworth*
Dr J. A. Edgington, w.e.f. 11 April 2002
R. S. R. Fitter
R. W. Hale
Mrs L. Hewitt
Dr J. F. Hewlett
P. C. Holland
K. H. Hyatt
A. J. Leppard*
D. C. McClintock, deceased November 2001
Dr I. S. Menzies
D. J. Montier*
E. M. Nicholson
R. M. Payne
C. W. Plant
Mrs C. M. Schmitt
P. J. Sellar
R. A. Softly
Miss F. J. Turtle
M. J. West*
H. M. V. Wilsdon*

*Members of Administration and Finance Committee as at 30 June 2002.

Treasurer's report for 2001/2002

At the end of the financial year on 30 June 2002, the total net assets of the Society were £376,714, compared with £444,513 the previous year, representing a decrease of around 15 per cent.

Income for year totalled £27,192, compared with £31,612 in 2000/1. Subsequent income at £17,314 was above the previous year's figure of £15,766. Sales of the Society's various publications generated £1,308, compared with £1,253 in the previous year. Investment income fell from £13,933 to £8,120, reflecting a change in the mix of the investment portfolio.

At the end of the year the market value of the Society's portfolio of listed investments stood at £365,509. At the end of the previous year a total of £448,406 of investments was held by the Society. This included £122,792 of investments that were sold shortly before the end of the year end, and were temporarily held in a bank deposit account while the Society changed to a new investment manager. The remainder of the portfolio then held by the Society was sold in September 2001 and the proceeds, together with £110,000 of the funds held on deposit since June 2001, were invested in a portfolio with the new investment manager.

Overall expenditure during the year was £39,560, compared with £41,709 in the previous year.

Reserves Policy

The majority of unrestricted general funds can be regarded as expendable endowment since they are invested to provide a regular source of income as well as capital growth for the Society.

Statement of trustees' responsibilities

Law applicable to charities in England and Wales requires the trustees to prepare financial statements for each financial year which give a true and fair view of the charity's financial activities during the year and of its financial position at the end of the year. In preparing those financial statements the trustees are required:

- to select suitable accounting policies and then apply them consistently;
- to make judgements and estimates that are reasonable and prudent;
- to state whether applicable accounting standards and statements of recommended practice have been followed subject to any departures disclosed and explained in the financial statements;
- to prepare the financial statements on the going concern basis unless it is inappropriate to presume that the charity will continue to operate.

The trustees are responsible for keeping accounting records which disclose with reasonable accuracy at any time the financial position of the charity and enable them to ensure that the financial statements comply with the Charities Act 1993. They are also responsible for safeguarding the assets of the charity and hence for taking reasonable steps for the prevention and detection of fraud or other irregularities.

Independent auditors' statement to the trustees of the London Natural History Society

We have examined the summarized financial statements set out below.

Respective responsibilities of trustees and auditors

The trustees are responsible for preparing the summarized financial statements in accordance with the recommendations of the charities SORP.

Our responsibility is to report to you our opinion on the consistency of the summarized financial statements with the full financial statements, on which we reported to you on 17 October 2002 and Annual Report. We also read the other information contained in the summarized annual report and consider the implications for our report if we become aware of any apparent misstatements or material inconsistencies with the summarized financial statements.

Basis of opinion

We conducted our work in accordance with Bulletin 1999/6 'The auditors' statement on the summary financial statement' issued by the Auditing Practices Board for use in the United Kingdom.

Opinion

In our opinion the summarized financial statements are consistent with the full financial statements and the Annual Report of the London Natural History Society for the year ended 30 June 2002.

1st Floor
46 Clarendon Road
Watford, Herts. WD17 1HE

28 October 2002

BAKER TILLY
Chartered Accountants
and Registered Auditors

Summarized accounts for the year ended 30 June 2002

These summarized accounts have been extracted from the Society's annual accounts for 2001/2002. They may not contain sufficient information to provide a full understanding of the financial affairs of the Society. For further information the full accounts, the auditors' report on these accounts and the trustees' report should be consulted. Copies can be obtained from the Society's Hon. Treasurer, M. J. West, 52 Trinity Road, Ware, Hertfordshire SG12 7DD.

The annual accounts were approved by the trustees on 17 October 2002.

Summarized statement of financial activities for the year ended 30 June 2002

	Unrestricted general funds 2002 £	2001 £
Incoming resources		
Activities in furtherance of the charity's objects:		
Subscriptions received from members	17,314	15,766
Publications/journals income	1,308	1,253
Interest receivable	300	245
Investment income	8,120	13,933
Other income	150	415
Total incoming resources	27,192	31,612
Resources expended		
Costs of generating funds	(2,592)	5,186
Net incoming resources available for charitable application	29,784	26,426
Costs in furtherance of the charity's objects:		
Publications and other costs	34,221	30,975
Management and administrative expenses	7,931	5,548
Total resources expended	42,152	36,523
Net outgoing resources before revaluations and investment asset disposals	(12,368)	(10,097)
Losses on investment assets	(55,431)	(53,586)
Net movement in funds	(67,799)	(63,683)
Fund balance brought forward at 1 July	444,513	508,196
Fund balance carried forward at 30 June	£376,714	£444,513

Balance sheet as at 30 June 2002

	2002 £	2001 £
Fixed assets		
Tangible fixed assets for use by charity	2,056	2,006
Investments at market value: listed	365,509	325,614
cash	5,627	(382)
	373,192	327,238
Net current assets	3,522	117,275
Total net assets	£376,714	£444,513
Represented by:		
Unrestricted funds	£376,714	£444,513

Official and sectional reports for 2002

CONSERVATION

In January 2002 the London Biodiversity Partnership (of which the Society is an active Partner) published a second round of action plans as part of the unfolding London Biodiversity Action Plan (LBAP). These new plans cover acid grassland, the tidal Thames, canals, churchyards and cemeteries, private gardens and parks, squares and amenity grassland. There are also two new species action plans covering reptiles and the native black poplar tree. Members of our Society are involved in carrying forward elements of all these plans. We are, for example, through the Botany Section, the lead partner in carrying out a survey of existing native black poplars. This has resulted in the discovery of several new records of the tree which is very scarce in the London area.

The Mayor's long awaited Biodiversity Strategy, 'Connecting With London's Nature', was launched at City Hall on 31 July 2002. The event came at the end of an exhaustive period of consultation following publication of the draft Strategy in September 2000. Many individuals and organizations, including the LNHS, provided detailed comments and suggestions on ways of strengthening the draft and it is encouraging to find that the final document has incorporated many of these. Most of its policies and proposals will be implemented through the LBAP process. The Strategy was reviewed in last year's *London Naturalist* (No. 81: 66).

The Nature Conservation Working Group's activities have been much reduced this year, following the tragic early death of our secretary Ruth Day in March 2002. We are, however, pleased to report that Freda Turtle has now agreed to take on this role and was formally appointed in July 2002.

DAVID BEVAN, *Conservation Officer*

BOTANY

The Botany Section organized three indoor meetings: in March Rodney Burton spoke about his garden in Kent, in October Peter Gasson of the Jodrell Laboratory at Kew showed some of his natural hsitory slides, and at the AGM in November Chris Preston talked about changes in the British flora, with reference to the *New atlas of the British and Irish flora.* There were also three informal meetings: the usual best botanical slides of the year in January; and two plant identification sessions in June and July guided by George Hounsome and Rodney Burton.

There has been the usual diversity of field meetings, ranging from central London to as far away as Bicester (north of Oxford) and the cliffs of Dover. During the course of the year we went for winter walks in Oxleas and Mickleham Woods, in spring there were visits to Darlands Lake (a joint meeting with the Wild Flower Society), Warley Place and West Drayton; and in the summer we went to Shoeburyness, West End Common, Croydon Airport, Wimbledon Common, Samphire Hoe near Dover (another joint meeting with the WFS), Oxfordshire Meads, Syon House, Greywell Moor, East India Docks, Kings Mead, Epping Forest, Staines Moor, Chelsea Physic Garden and Epsom Common (a joint meeting with the British Plant Gall Society); and in the autumn we were able to go to Ashdown Forest, Wendover and Oxhey Wood, with a final fungus foray in Haringey in October. In addition the Hawkinses went with a select group to botanize on the Isle of Skye.

We are as always very grateful to all the speakers and leaders who give us their time and expertise, and we thank our meetings secretaries for the hard work involved in organizing these meetings. Our gratitude also to our two energetic and hard-working Recorders, Rodney Burton and Amanda Waterfield.

DAVID BEVAN, *Chairman*, MARY CLARE SHEAHAN, *Secretary*

ECOLOGY AND ENTOMOLOGY

First of all, we must sadly report the death in March of Ruth Day, our enthusiastic Dragonfly Recorder and a valuable member of the committee. We, and the Society at large, will miss her greatly.

The first indoor meeting of the year, this time in February, is traditionally an informal one and yet again members impressed us with their photographic skill and natural history knowledge. In May Ray Uffen, our Hymenoptera Recorder, spoke on 'Bees, the entomologist's equivalent of birds'. Our annual joint meeting with the British Entomological and Natural History Society in September for the Brad Ashby Memorial Lecture was addressed by Richard Jones on his research into the invertebrate fauna found on green roofs. In December Emily Funnell of Butterfly Conservation spoke to us about 'Conserving butterflies and moths in London'.

The Section's AGM in October followed the successful formula of recent years with reports from Recorders; in 2002 the featured report was from Fish Recorder, Ruth Kirk, who spoke about 'Alien invaders', concentrating on aquatic invaders such as signal crayfish, Chinese mitten crabs and American mink. At that meeting we accepted with regret the resignation of John Thompson as Section Chairman and of David Allen as Reading Circle Secretary. Malcolm Bridge was elected as new Reading Circle Secretary and Neil Anderson as Recorder of Odonata. We are still searching for more members willing to join us to carry on the work of the Section and the Society.

Four field trips were organized during the year. Spider Recorder, Edward Milner, led the first to Mile End Park in May. Here we found a species of jumping spider, *Macaroeris nidicolens*, new to Britain, and two species, *Theridion pinastri* and *Misumena vatia*, new to London. Darlands Lake in June was a pleasant day looking at natural history generally. On a July evening we revisited a site where glow-worms had been found last year and saw them again. In August Sandi Bain, Orthoptera Recorder, led a trip to Richmond Park where we found several species of grasshoppers and crickets and, notably, three wasp spiders.

Two members who had recently joined the Society attended an open committee meeting in February to find out how the Society operates.

Once again the Section represented the Society at the Amateur Entomologists' Society exhibition, selling books and journals as well as making our work known to a wider public.

CATHERINE SCHMITT, *Secretary*

ORNITHOLOGY

This year the Ornithology Section continued to expand and there was a large increase in the number of field meetings. There was a varied programme of indoor meetings with talks on Antarctica, the Dominican Republic and Cuba and, closer to home, with Fair Isle. The talks were given by eminent ornithologists such as Tim Loseby and Chris Bradshaw and, at the AGM, Su Gough described the BTO London Bird Project.

The coach trips, arranged and led by Neil Anderson, ranged from Slimbridge for wildfowl, where participants were fortunate in seeing a perched goshawk, to a car park at Tesco's to see waxwings while en route to Rutland Water. On the Isle of Sheppey trip to see wildfowl, two rough-legged buzzards were a bonus.

Fourteen field meetings were organized by Jennifer Hayden. They varied from specific trips for migration at Walthamstow Reservoirs and the Charlton area, to mandarin ducks at dusk in Grovelands Park, to gull identification, again in the Charlton area. Others included Staines Reservoir, Sevenoaks Wildfowl Reserve, The London Wetland Centre, North Kent Marshes, Beddington Sewage Farm, Regent's Park and Trent Park. These trips have significantly increased under the leadership of Jennifer.

The 1999 *London Bird Report* was published and work has now started on the 2000 report. Also during the year *The breeding birds of the London Area* was finally published; special thanks are due to Jan Hewlett for bringing this project to fruition.

The Research Committee has continued to assist with a number of projects.

DAVID DARRELL-LAMBERT, *Chairman*, NICOLA DUCKWORTH, *Secretary*

Ancient woodland indicator plants in Croydon

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Abstract

Ancient Woodland Vascular Plants (AWVPs) were counted in fifty-seven woods in Croydon. Seventy plants from the list for SE England were recorded, in totals of one to forty species in each wood. The variables determining these totals (size of wood, soil type, location, environment and visitor pressure) are discussed.

Introduction

A count of the number of flowering plants has long been used to evaluate woods for nature conservation. In general, older habitats support more species, and species-rich sites are more important for nature conservation. Rose (1999) refers to the list of Ancient Woodland Vascular Plants (AWVPs) produced by the Nature Conservancy Council in 1987. The list for south-east England, which includes Surrey and London, comprises 100 species. A high AWVP score is considered to be a reliable indication of natural diversity, and indicative of ancient or primary woodland. However, the author advises caution in merely applying the number of species; the list should be used as a tool rather than an infallible guide, as other factors such as soil type and proximity to other woods will affect the number of AWVPs.

Although the London Borough of Croydon is primarily urban, it still has substantial areas of open space, including much woodland. Parts of Croydon retain names derived from woodland, for example Norwood, Selhurst, Whyteleafe and Woodside. Woodland is catalogued in the *Domesday Book* (1975). Croydon had woodland 'at 200 pigs'; and of the other villages which are now part of the Borough, Addington, twenty pigs; Coulsdon, three pigs; and Sanderstead, thirty pigs. The relation between the number of pigs and woodland area is uncertain (Rackham 1976).

'Ancient woodland' is a term used to describe woodland appearing on maps by 1600, the date of the earliest estate maps, which is assumed to be land which has always been wooded (Rackham 1986). These woods will, of course, have been more or less heavily managed throughout their history. Croydon has a good historical record of maps. The earliest reliable map is John Rocque's map of Surrey (Rocque 1762). This map is at a scale of about two inches to the mile. Features which still exist today are easily identifiable, for example Ibbett's Piece, an unusually shaped field in Sanderstead (Gadsby 1993). This is good evidence for the accuracy of the map, although no guarantee that all features, including woods, are shown. Later maps, covering all or part of the present London

Borough of Croydon, were made by Bainbridge (1785, 1800), Roberts (1847), up to the Ordnance Survey(1898) maps of the late nineteenth century, which show Croydon immediately before the great twentieth century urbanization. All the woods recorded in this survey (i.e. those which are still woods today) which are shown on the Rocque map can be traced consistently through all these later maps.

The woods

The woods were selected from personal knowledge and by their appearance on current maps. All the substantial areas of woodland in Croydon with public access were recorded. Most of these are owned by the London Borough of Croydon, with a few owned by the Corporation of London or The National Trust. Six woods fall within Croydon's three SSSIs, although these were not designated primarily, or even at all, for the woodland.

Table 1 shows the physical features of the woods. Areas for the woods were obtained from Clenet, Britton and Game (1988), Winterman (1988), Game (1993), and for woods which comprise only part of a larger whole, using the 'Atlas 2000 Plotter', a squared-off transparent overlay designed by Roger Whitehead. Soil types were obtained from geological maps (British Geological Survey, 1978, 1981) and show the predominant soil type for each wood. Names for the woods are the modern names as used by the owners (Winterman 1988, Clenet, Britton and Game 1988).

Croydon has a few large woods. Kings Wood and Addington Hills are both more than fifty hectares in area; Croham Hurst and Littleheath Woods are more than twenty-five hectares. Most woods are small, less than five hectares in area (twenty-eight out of the total of fifty-seven). Many of these are remnants of formerly much larger woods, for example Spring Park Wood and the Great North Wood fragments in Norwood. Some sites have been much less wooded in the past, for example Croham Hurst, which has a summit of heathland and was formerly more open. A postcard is reproduced in Winterman (1988).

Recording

Consistency of recording is important to produce reliable results (Kirby 2001, Rich and Woodruff 1992). Efforts were made to ensure recording was complete (recording a specific list of plants rather than all species present made this easier).

Each wood was visited at least twice during 2000 and 2001, and the presence of species from the AWVP list recorded. The visits were made between April and August, so that all species could be seen. Some plants, for example moschatel *Adoxa moschatellina*, are only visible early in the year, because of their early flowering, or in some woods, small plants are difficult to find because they become overgrown later in the year. Late visits are necessary to record other species, for example black bryony *Tamus communis*.

The AWVP list includes species which should be considered 'only if they occur well within the wood and do not appear to have been planted'. Some garden escapes are obvious, for example Spanish bluebell *Hyacinthoides hispanica*, or the cultivated yellow archangel *Lamiastrum galeobdolon* ssp. *argentata*, and these were not recorded. Other plants were recorded without any judgement about their origins. These include hornbeam *Carpinus betulus*, pendulous sedge *Carex pendula* and guelder-rose *Viburnum opulus*. The hybrid hawthorn *Crataegus* × *media* (*C. monogyna* × *C laevigata*) was considered to be evidence of the occurrence of midland hawthorn *C. laevigata*, and was recorded as this species.

The time spent in each wood was recorded. Large woods necessarily take longer to walk around than small woods. The extensive local knowledge of the recorders, although introducing a sort of 'personal bias', ensured that uncommon species should be better recorded than if the survey was conducted by recorders unfamiliar with the woods.

Results

Seventy plants from the list of AWVPs were recorded in Croydon's woods. Total numbers recorded ranged from forty species in Kings Wood to one species in Foxearth Spinney (Table 2). Some species (bluebell *Hyacinthoides non-scripta*, holly *Ilex aquifolium* and wild cherry *Prunus avium*) were present in all or almost all sites. Eleven species were recorded from only one location. These plants are rare in Croydon — these records may be their only site — but are not necessarily rare in a regional or national context.

The number of species recorded increased with the size of the wood, although the scatter is considerable, and the small number of large woods results in uncertainty (R squared = 0.155, using the linear regression function in Microsoft Excel). The number of species is more closely related to the time spent recording (R squared = 0.520). However, time is itself related to the size of the wood (R squared = 0.302), simply because a large wood takes longer to walk round than a small one.

Therefore, there are other important factors as well as the size of the wood which determine the number of species. Not all the richest woods, in terms of number of species, are the largest. Although two out of the three largest sites, Kings Wood and Croham Hurst, have the highest number of species, some very small woods, Inwood and Three Corner Grove, also have high totals. These two small woods are both on chalk and appear on Rocque's map.

Woods have more or fewer species than would be predicted from their size. Table 3 shows the total species recorded and the expected number of species, calculated from the regression equation. The woods are ranked according to the difference between the observed and expected number of species. The woods at the top of the table, therefore, have more species than would be expected from their size, and those at the bottom have fewer than expected. From this, the effect of other variables determining the number of species can be more easily seen.

Woods which appear on the oldest map (Rocque) have more species than those which do not (Table 4). The total number of species found in the twenty-seven woods which appear on the Rocque map is higher than in the nineteen woods not on this map. The difference is statistically significant (99 per cent using Student's t-test). (The size difference between the two groups of woods is not significant). The remaining eleven woods were excluded from this calculation; they are partly wooded, existing as field boundaries, or not identifiable. However, the 'old' woods do not have consistently more species than would be expected for their size (Table 3). The obvious influence is the soil type. Woods on chalk, or with a chalk component in their soil, tend to have higher numbers of species, and woods on pebbles and sand the lowest numbers (Table 5). The effect of soil type is even more marked in Table 3. The ten most species-rich woods for their size are on chalk or chalk/clay. The woods on pebbles and sand all fall into the bottom half of the table, except for Croham Hurst, which is a large site, exceptionally rich in species, an SSSI, and includes a small chalk area in the southern corner. It is notable how many very small woods on chalk have high numbers of species.

The woods which appear at the bottom of Table 3, with few species for their size, are on sand, pebbles or London Clay, and are mostly not shown on Rocque's map. Those which are shown are on pebbles, or are the Great North Wood fragments, The Lawns and Beaulieu Heights, which are heavily used and are now not entirely wooded. Of the two woods on chalk, Purley Beeches suffered considerable damage in the Great Storm of October 1987 and no longer looks like a woodland, and Coulsdon Common Wood Pasture, whose name reflects its history as wood pasture, was probably used for grazing, rather than woodland.

Higher species totals are found in woods on chalk (Table 5), even though the mean area of these woods is quite small. Woods on London Clay, pebbles and

sand have lower species totals. The mean number of species for the three woods on pebbles/sand is high because it includes the very rich site of Croham Hurst.

There are more plant species from the AWVP list which favour chalky soils. The lists of plants in Table 6 are those which were found in more than eighty per cent of woods on the particular soil type, with a substantially lower presence in woods on other soils (a difference of about twenty percentage points, although an absolute cut-off point was difficult to choose). Therefore, using a count of AWVP species as a measure of 'value' would favour woods on chalk. Woods on non-chalk soils would be undervalued, although they have species which are uncommon in Croydon. There are fewer woods on these soils, and they are concentrated in the more urban north of the Borough, which has much less open space, including woods. These sites are heavily used; it is obvious when visiting these woods that there are trampled patches devoid of understorey, which is also likely to be a factor in species survival.

A considerable number of the plants (twenty-three out of seventy species have a difference of twenty percentage points or more between their occurrence in woods which appear on Rocque's map and those which do not appear) are found preferentially in the 'old' woods (shown on Rocque's map) (Table 7). This would be expected as this list has already been selected as being characteristic of ancient woodland. In Table 7, the plants are ranked according to the difference in occurrence in 'old' and 'new' woods. The plants at the top of the table are overwhelmingly from the list of plants found more in woods on chalk (thirteen species), or plants with no preference (eight species). There are also a smaller number of plants found more in 'new' woods, and all show a difference of less than twenty percentage points.

Discussion

There are many factors determining the number of Ancient Woodland Vascular Plants in a wood. Counts of the AWVP species in woods cannot be used to compare their 'value', because the woods may differ in so many ways. Large woods are likely to have more species than small ones, but many small woods have high species counts (more than twenty-five) in the context of this survey. Most of these are on chalk, are known to be old woods (shown on our oldest map, that of Rocque), and adjacent to other woods, or part of woods which were formerly much larger. Some of our largest woods have comparatively modest totals. These are on pebbles or sand, are not shown on Rocque's map, or subject to disturbance and trampling.

Croydon's history is one of woodland (and other open space) destruction due to urbanization, rather than woodland creation. This survey could only record woods which still exist, and inspection of any of the maps consulted here reveals many other woods which have now disappeared under buildings. There are woods which have been planted, for example the eighteenth century Sanderstead Plantation (J. Gadsby, personal communication). Some of the woods not shown on Rocque's map can be traced through time on the later maps to be fields which have 'filled in' from the surrounding hedges. Examples are Pitlands Wood, which is shown as partly wooded along the south and east sides in Bainbridge (1785), and Ashen Grove, which had a strip of woodland along its north side in 1800. Old hedges may be the remnants of former woods whose centre was grubbed out to make a field, and may therefore retain some of the original woodland plants (Rackham 1986). These plants may then spread into the field if it later becomes a wood again.

Other woods are fragments of once much larger woods. The Great North Wood still covered a substantial proportion of the north of the Borough in 1800; Norwood was built up by 1898 and the woodland fragments of Biggin Wood, Stambourne Woodland Walk, The Lawns, Beaulieu Heights and Grangewood Park were much the same in area as they are today. In the east of the Borough, Spring Park Wood, Temple Avenue Copse, Foxes Wood, Shirley Heath and

Pinewoods were in 1898 part of the original large Springpark Wood and Kennel Wood, which also adjoined Threehalfpenny Wood to the south-east and the then wooded Addington Park to the south-west.

Proximity to larger woods, or being a larger wood remnant, may be another factor in determining the number of AWVPs, although other factors, especially soil type, seem to have a larger effect. It may explain why some very small woods are exceptionally rich in species, for example Three Corner Grove, which is a fairly undisturbed wood apart from some rubbish dumping, adjacent to the larger Frylands Wood (outside the Borough of Croydon); and Ragged Grove, which is part of a system of small woods and extended hedgerows, also including Mitchley Wood and Anslie Berry Shaw.

Not all the AWVP species are more common in 'old' woods in Croydon. Those at the top of Table 8 could be used as a guide to whether a wood is old, but these plants are mostly associated with woods on chalky soil, and would be a poor guide for woods on other soils. However, this survey covered only Croydon, and the results do not indicate how useful this guide would be over a wider geographical area.

Rose (1999) gives a list of the richest sites in the south-east for AWVPs. These are mostly large woods in rural areas, and have species counts of thirty-six to seventy-four species from the AWVP list. In Croydon, there is one wood with forty species (Kings Wood), and a further six woods with thirty or more. Even with the proviso that a crude count of species should not be used as a measure without considering other variables, in this London Borough, an urban area with generally fragmented open spaces subject to considerable visitor pressure, these totals indicate that our woods are of exceptional conservation interest, in addition to their scenic and amenity value.

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Copies of the maps are in the Library of the Croydon Natural History and Scientific Society Ltd, or in the London Borough of Croydon Local Studies Library.

Table 1: Woods in the London Borough of Croydon

	Wood	Location	Grid ref. TQ	Area ha	Soil type	Appears on Rocque's map	Number of visits	Time hours	Total AWVP species
1	Biggin Wood	Upper Norwood	317702	5.5	London Clay	Y	3	3.25	18
2	Stambourne Woodland Walk	Upper Norwood	336702	1.9	London Clay	Y	3	2.00	9
3	The Lawns	Upper Norwood	328698	6.3	London Clay	Y	2	1.50	12
4	Beaulieu Heights	Upper Norwood	334695	7.1	London Clay	Y	2	1.75	11
5	Grangewood Park	South Norwood	330690	11.2	London Clay	Y	3	2.25	21
6	Long Lane Woods	Monks Orchard	355675	6.1	pebbles	Y	3	1.50	13
7	Spring Park Wood	Shirley	374655	2.8	pebbles	Y	2	1.50	9
8	Temple Avenue Copse	Shirley	367653	0.4	pebbles	N	2	1.00	9
9	Foxes Wood	Shirley	365650	3.2	pebbles	N	3	1.75	10
10	Pinewoods	Shirley	360651	4.5	pebbles	N	3	3.50	13
11	Lloyd Park	Croydon	343650	0.5	chalk	Y	3	2.00	17
12	Shirley Park Estate	Shirley	348647	4.5	pebbles/sand	N	2	0.75	5
13	Shirley Heath	Shirley	371649	7.0	pebbles	Part	2	2.50	18
14	Threehalfpenny Wood	Addington	378648	10.1	pebbles	Y	3	3.75	26
15	Addington Hills	Shirley	353645	52.6	pebbles	N	3	4.25	12
16	Coombe Wood	South Croydon	346644	5.7	pebbles	N	2	1.50	10
17	Birchwood & Castle Hill Ruffs	New Addington	385639	15.2	chalk	Y	3	3.75	28
18	Bramley Bank	Shirley	352634	9.7	pebbles/sand	Y	2	2.75	19
19	Croham Hurst	South Croydon	342629	34.3	pebbles/sand	Y	3	4.75	35
20	The Ruffett	South Croydon	350633	1.0	pebbles	?	2	0.75	11
21	Littleheath Wood	Selsdon	350628	25.9	clay/flints	Part	2	2.75	33
22	Foxearth Spinney	Selsdon	353626	0.1	sand	?	2	0.50	1
23	Ladygrove	Forestdale	362625	0.1	chalk	N	3	1.50	16
24	Ashen Grove	Forestdale	360624	1.5	chalk	N	3	1.50	17
25	Rowdown Wood	New Addington	390630	13.8	clay/flints	FB	3	3.00	27
26	Boundary Woods	New Addington	393620	1.7	clay/flints	FB	2	1.75	9
27	Purley Beeches	Sanderstead	329619	7.2	chalk	N	2	1.25	11
28	Sanderstead Plantation	Sanderstead	344619	8.8	sand	N	2	2.50	20
29	Fox Shaw	Selsdon	360620	4.0	chalk/clay	Y	3	1.75	18

	Wood	Location	Grid ref. TQ	Area ha	Soil type	Appears on Rocque's map	Number of visits	Time hours	Total AWVP species
30	Selsdon Wood (Court Wood)	Selsdon	366621	8.1	chalk/clay	Y	3	2.25	29
31	Selsdon Wood (Hillocks Wood)	Selsdon	360613	4.9	chalk/clay	Y	3	3.00	30
32	Selsdon Wood	Selsdon	365620	12.0	chalk/clay	Y	3	4.25	33
33	Three Corner Grove	New Addington	385612	1.6	chalk	Y	3	2.00	31
34	Foxley Wood	Purley	315605	7.0	chalk	Y	3	1.75	20
35	Higher Drive Shaw	Purley	315579	1.0	clay/flints	Y	3	1.75	17
36	Combes Wood	Purley	325605	4.0	clay/flints	Y	3	2.25	13
37	Mitchley Wood	Purley	338604	9.0	chalk	Y	4	2.75	29
38	Ragged Grove	Sanderstead	338605	1.2	chalk	FB	3	3.00	28
39	Anslie Berry Shaw	Sanderstead	341599	6.0	clay/flints	Y	4	4.25	27
40	Kings Wood	Sanderstead	351603	59.7	clay/flints	Y	2	4.00	40
41	Mossy Hill Shaw	Farleigh	360602	3.0	chalk	Y	3	2.50	25
42	Postern Wood	Coulsdon	290589	2.0	chalk	Y	2	1.50	17
43	Mother Kitty's Shaw	Coulsdon	286586	0.5	pebbles	?	2	1.00	8
44	Coulsdon Court Wood	Coulsdon	312592	12.0	chalk	N	3	2.00	23
45	Colescroft Shaw	Coulsdon	316595	6.0	chalk	N	3	2.75	20
46	Coulsdon Coppice	Coulsdon	307589	1.5	chalk	N	3	3.00	19
47	Inwood	Coulsdon	315579	2.0	chalk	Y	4	3.50	35
48	Betts Mead	Kenley	322585	1.7	clay/flints	N	3	1.75	22
49	Hawkhirst	Kenley	330594	14.4	clay/flints	Part	3	2.25	25
50	Pitlands Wood	Kenley	330587	5.0	clay/flints	N	3	3.00	24
51	Farthing Downs Tree Belt	Coulsdon	302575	2.8	chalk	FB	3	2.50	16
52	Rydons Wood	Coulsdon	324573	2.0	chalk	N	3	2.75	28
53	Crab Wood	Kenley	327574	0.8	clay/flints	N	3	2.75	18
54	Coulsdon Common Wood Pasture	Coulsdon	322570	18.0	chalk/clay	Part	2	2.00	13
55	Devilsden Wood	Coulsdon	302571	15.0	chalk	Y	4	3.75	28
56	Figgs Wood	Coulsdon	309565	3.5	clay/flints	N	3	1.25	11
57	Piles Wood	Coulsdon	313560	7.0	chalk	N	4	2.75	28

Y = wood appears on Rocque's map; N = wood does not appear on Rocque's map;
Part = shown partly wooded; FB = shown as field boundary; ? = unable to determine

TABLE 2. Total numbers of Ancient Woodland Vascular Plant species recorded.

	Wood	Soil type	Area ha	Appears on Rocque's map	Total AWVP species
40	Kings Wood	clay/flints	59.7	Y	40
19	Croham Hurst	pebbles/sand	34.3	Y	35
47	Inwood	chalk	2.0	Y	35
21	Littleheath Wood	clay/flints	25.9	Part	33
32	Selsdon Wood	chalk/clay	12.0	Y	33
33	Three Corner Grove	chalk	1.6	Y	31
31	Selsdon Wood (Hillocks Wood)	chalk/clay	4.9	Y	30
30	Selsdon Wood (Court Wood)	chalk/clay	8.1	Y	29
37	Mitchley Wood	chalk	9.0	Y	29
17	Birchwood & Castle Hill Ruffs	chalk	15.2	Y	28
38	Ragged Grove	chalk	1.2	FB	28
52	Rydons Wood	chalk	2.0	N	28
55	Devilsden Wood	chalk	15.0	Y	28
57	Piles Wood	chalk	7.0	N	28
25	Rowdown Wood	clay/flints	13.8	FB	27
39	Anslie Berry Shaw	clay/flints	6.0	Y	27
14	Threehalfpenny Wood	pebbles	10.1	Y	26
41	Mossy Hill Shaw	chalk	3.0	Y	25
49	Hawkhirst	clay/flints	14.4	Part	25
50	Pitlands Wood	clay/flints	5.0	N	24
44	Coulsdon Court Wood	chalk	12.0	N	23
48	Betts Mead	clay/flints	1.7	N	22
5	Grangewood Park	London Clay	11.2	Y	21
28	Sanderstead Plantation	sand	8.8	N	20
34	Foxley Wood	chalk	7.0	Y	20
45	Colescroft Shaw	chalk	6.0	N	20
18	Bramley Bank	pebbles/sand	9.7	Y	19
46	Coulsdon Coppice	chalk	1.5	N	19
1	Biggin Wood	London Clay	5.5	Y	18
13	Shirley Heath	pebbles	7.0	Part	18
29	Fox Shaw	chalk/clay	4.0	Y	18
53	Crab Wood	clay/flints	0.8	N	18
11	Lloyd Park	chalk	0.5	Y	17
24	Ashen Grove	chalk	1.5	N	17
35	Higher Drive Shaw	clay/flints	1.0	Y	17
42	Postern Wood	chalk	2.0	Y	17
23	Ladygrove	chalk	0.1	N	16
51	Farthing Downs Tree Belt	chalk	2.8	FB	16
6	Long Lane Woods	pebbles	6.1	Y	13
10	Pinewoods	pebbles	4.5	N	13
36	Combes Wood	clay/flints	4.0	Y	13
54	Coulsdon Common Wood Pasture	chalk/clay	18.0	Part	13
3	The Lawns	London Clay	6.3	Y	12
15	Addington Hills	pebbles	52.6	N	12
4	Beaulieu Heights	London Clay	7.1	Y	11
20	The Ruffett	pebbles	1.0	?	11
27	Purley Beeches	chalk	7.2	N	11
56	Figgs Wood	clay/flints	3.5	N	11
9	Foxes Wood	pebbles	3.2	N	10
16	Coombe Wood	pebbles	5.7	N	10
2	Stambourne Woodland Walk	London Clay	1.9	Y	9
7	Spring Park Wood	pebbles	2.8	Y	9
8	Temple Avenue Copse	pebbles	0.4	N	9
26	Boundary Woods	clay/flints	1.7	FB	9
43	Mother Kitty's Shaw	pebbles	0.5	?	8
12	Shirley Park Estate	pebbles/sand	4.5	N	5
22	Foxearth Spinney	sand	0.1	?	1

TABLE 3. Number of AWVP species and wood area.

Wood		Soil type	Area ha	Total number of species recorded	Expected number of species for area	Difference between actual and expected numbers of species
47	Inwood	chalk	2.0	Y	35	14.6	20.4
33	Three Corner Grove	chalk	1.6	Y	31	13.9	17.1
38	Ragged Grove	chalk	1.2	FB	28	13.0	15.0
52	Rydons Wood	chalk	2.0	N	28	14.6	13.4
31	Selsdon Wood (Hillocks Wood)	chalk/clay	4.9	Y	30	17.9	12.1
32	Selsdon Wood	chalk/clay	12.0	Y	33	21.9	11.1
41	Mossy Hill Shaw	chalk	3.0	Y	25	16.0	9.0
30	Selsdon Wood (Court Wood)	chalk/clay	8.1	Y	29	20.0	9.0
57	Piles Wood	chalk	7.0	N	28	19.4	8.6
23	Ladygrove	chalk	0.1	N	16	7.4	8.6
37	Mitchley Wood	chalk	9.0	Y	29	20.5	8.5
40	Kings Wood	clay/flints	59.7	Y	40	31.5	8.5
39	Anslie Berry Shaw	clay/flints	6.0	Y	27	18.7	8.3
48	Betts Mead	clay/flints	1.7	N	22	14.1	7.9
19	Croham Hurst	pebbles/sand	34.3	Y	35	27.8	7.2
21	Littleheath Wood	clay/flints	25.9	Part	33	26.1	6.9
11	Lloyd Park	chalk	0.5	Y	17	10.7	6.3
53	Crab Wood	clay/flints	0.8	N	18	11.9	6.1
50	Pitlands Wood	clay/flints	5.0	N	24	18.0	6.0
46	Coulsdon Coppice	chalk	1.5	N	19	13.7	5.3
55	Devilsden Wood	chalk	15.0	Y	28	23.1	4.9
14	Threehalfpenny Wood	pebbles	10.1	Y	26	21.1	4.9
17	Birchwood & Castle Hill Ruffs	chalk	15.2	Y	28	23.1	4.9
35	Higher Drive Shaw	clay/flints	1.0	Y	17	12.5	4.5
25	Rowdown Wood	clay/flints	13.8	FB	27	22.6	4.4
24	Ashen Grove	chalk	1.5	N	17	13.7	3.3
42	Postern Wood	chalk	2.0	Y	17	14.6	2.4
49	Hawkhirst	clay/flints	14.4	Part	25	22.8	2.2

Wood		Soil type	Area ha	Total number of species recorded	Expected number of species for area	Difference between actual and expected numbers of species
45 Colescroft Shaw	chalk	6.0	N	20	18.7	1.3
44 Coulsdon Court Wood	chalk	12.0	N	23	21.9	1.1
29 Fox Shaw	chalk/clay	4.0	Y	18	17.1	0.9
34 Foxley Wood	chalk	7.0	Y	20	19.4	0.6
51 Farthing Downs Tree Belt	chalk	2.8	FB	16	15.8	0.2
1 Biggin Wood	London Clay	5.5	Y	18	18.4	-0.4
28 Sanderstead Plantation	sand	8.8	N	20	20.4	-0.4
5 Grangewood Park	London Clay	11.2	Y	21	21.6	-0.6
8 Temple Avenue Copse	pebbles	0.4	N	9	10.1	-1.1
13 Shirley Heath	pebbles	7.0	Part	18	19.4	-1.4
20 The Ruffett	pebbles	1.0	?	11	12.5	-1.5
18 Bramley Bank	pebbles/sand	9.7	Y	19	20.9	-1.9
43 Mother Kitty's Shaw	pebbles	0.5	?	8	10.7	-2.7
36 Combes Wood	clay/flints	4.0	Y	13	17.1	-4.1
10 Pinewoods	pebbles	4.5	N	13	17.5	-4.5
26 Boundary Woods	clay/flints	1.7	FB	9	14.1	-5.1
2 Stambourne Woodland Walk	London Clay	1.9	Y	9	14.4	-5.4
56 Figgs Wood	clay/flints	3.5	N	11	16.6	-5.6
6 Long Lane Woods	pebbles	6.1	Y	13	18.8	-5.8
9 Foxes Wood	pebbles	3.2	N	10	16.2	-6.2
22 Foxearth Spinney	sand	0.1	?	1	7.4	-6.4
7 Spring Park Wood	pebbles	2.8	Y	9	15.8	-6.8
3 The Lawns	London Clay	6.3	Y	12	18.9	-6.9
4 Beaulieu Heights	London Clay	7.1	Y	11	19.5	-8.5
16 Coombe Wood	pebbles	5.7	N	10	18.5	-8.5
27 Purley Beeches	chalk	7.2	N	11	19.5	-8.5
54 Coulsdon Common Wood Pasture	chalk/clay	18.0	Part	13	24.0	-11.0
12 Shirley Park Estate	pebbles/sand	4.5	N	5	17.5	-12.5
15 Addington Hills	pebbles	52.6	N	12	30.7	-18.7

TABLE 4. Difference in AWVP species between 'old' and 'new' woods

	Number of woods	Mean area ha	Mean number AWVP species
woods shown on Rocque ('old' woods)	27	9.3	22.6
woods not on Rocque ('new' woods)	19	6.7	16.6
difference between old and new (Student's t-test)		not significant	0.01

TABLE 5. Dependence of number of AWVP species on soil type.

Soil	Number of woods	Mean area ha	Mean number of AWVP species
chalk/clay	5	9.4	24.6
chalk	19	5.1	22.9
clay/flints	12	11.5	22.2
pebbles/sand	3	16.2	19.7
London Clay	5	6.4	14.2
pebbles	11	8.5	12.6
sand	2	4.5	10.5

TABLE 6. Soil type perefence of AWVP species.

Prefers C CC CF	Prefers CF LC	Rare - 1–3 records	No obvious pattern related to soil
Acer campestre	*Dryopteris carthusiana*	*Blechnum spicant*	*Adoxa moschatellina*
Anemone nemorosa	*Populus tremula*	*Daphne laureola*	*Allium ursinum*
Bromopsis ramosa		*Frangula alnus*	*Aquilegia vulgaris*
Carex sylvatica	**Prefers LC PS**	*Helleborus viridis*	*Campanula trachelium*
Conopodium majus	*Luzula forsteri*	*Hypericum pulchrum*	*Carex pendula*
Crataegus laevigata	*Quercus petraea*	*Iris foetidissima*	*Carpinus betulus*
Dryopteris affinis		*Lathyrus linifolius*	*Elymus caninus*
Festuca gigantea	**Prefers P PS S**	*Narcissus pseudonarcissus*	*Euphorbia amygdaloides*
Lamiastrum galeobdolon	*Carex remota*	*Orchis mascula*	*Galium odoratum*
Lathraea squamaria	*Convallaria majalis*	*Paris quadrifolia*	*Holcus mollis*
Luzula pilosa	*Polygonatum multiflorum*	*Ruscus aculeatus*	*Hyacinthoides non-scripta*
Lysimachia nemorum		*Sedum telephium*	*Hypericum androsaemum*
Malus sylvestris		*Solidago virgaurea*	*Ilex aquifolium*
Melica uniflora		*Vaccinium myrtillus*	*Moehringia trinervia*
Milium effusum		*Viola palustris*	*Poa nemoralis*
Oxalis acetosella			*Potentilla sterilis*
Phyllitis scolopendrium			*Prunus avium*
Polystichum setiferum			*Ribes nigrum*
Primula vulgaris			*Ribes rubrum*
Ranunculus auricomus			*Sanicula europaea*
Rosa arvensis			*Tamus communis*
Viburnum opulus			*Tilia cordata*
Vicia sepium			*Ulmus glabra*
Viola reichenbachiana			*Veronica montana*

C = chalk; CC = chalk/clay; CF = clay/flints; LC = London Clay
P = pebbles; PS = pebbles/sand; S = sand

TABLE 7. wood 'age' preference of AWVP species.

	Recorded from 'old' woods %	Recorded from 'new' woods %	Difference in occurrence (old–new) %
Oxalis acetosella	55	6	48
Euphorbia amygdaloides	50	6	44
Melica uniflora	68	25	43
Poa nemoralis	59	25	34
Ulmus glabra	64	31	32
Luzula pilosa	32	0	32
Crataegus laevigata	50	19	31
*Primula vulgaris**	50	19	31
Potentilla sterilis	36	6	30
Holcus mollis	73	44	29
*Malus sylvestris**	59	31	28
Vicia sepium	50	25	25
Moehringia trinervia	36	13	24
Anemone nemorosa	86	63	24
Carex sylvatica	86	63	24
Sanicula europaea	55	31	23
Lysimachia nemorum	23	0	23
Populus tremula	23	0	23
Lamiastrum galeobdolon	59	38	22
Conopodiurn majus	27	6	21
Galium odoratum	27	6	21
Viola reichenbachiana	77	56	21
*Quercus petraea**	45	25	20
*Acer campestre**	82	63	19
Luzula forsteri	18	0	18
*Carpinus betulus**	36	19	18
Veronica montana	55	38	17
Carex remota	23	6	16
Lathraea squamaria	23	6	16
Dryopteris affinis	27	13	15
Hypericum androsaemum	14	0	14
*Ribes nigrum**	14	0	14
Rosa arvensis	68	56	12
*Tilia cordata**	18	6	12
*Viburnum opulus**	36	25	11
Dryopteris carthusiana	9	0	9
Orchis mascula	9	0	9
Elymus caninus	14	6	7
Prunus avium	100	94	6
*Carex pendula**	36	31	5
Festuca gigantea	55	50	5
Hypericum pulchrum	5	0	5
Lathyrus linifolius	5	0	5
*Narcissus pseudonarcissus**	5	0	5
Paris quadrifolia	5	0	5
Vaccinium myrtillus	5	0	5
*Ribes rubrum**	73	69	4
Campanula trachelium	14	13	1
*Phyllitis scolopendrium**	14	13	1
Polystichum setiferum	14	13	1
Frangula alnus	0	0	0
Hyacinthoides non-scripta	100	100	0
Ilex aquifolium	100	100	0
Solidago virgaurea	0	0	0
Viola palustris	0	0	0
Bromopsis ramosa	55	56	-2
Ruscus aculeatus	5	6	-2
Tamus communis	41	44	-3
*Aquilegia vulgaris**	9	13	-3
Alliurn ursinum	14	19	-5
Blechnum spicant	0	6	-6
*Daphne laureola**	0	6	-6
*Helleborus viridis**	0	6	-6
Ranunculus auricomus	36	44	-7
Iris foetidissima	5	13	-8
Polygonatum multiflorum	5	13	-8
Milium effusum	14	25	-11
Sedum telephium	0	13	-13
*Convallaria majalis**	5	19	-14
Adoxa moschatellina	27	44	-16

A method for estimating the age of yew trees from their circumference

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Abstract

Measurements of yew trees in churchyards in Croydon and Surrey taken in 1880 and 1994 were used to estimate growth rates and ages of the trees. Although the sample was small (twenty-four trees) and the trees very variable in growth rate, the evidence suggests that yews grow at the same rate as other trees, and the ages of very large trees are probably not to be measured in thousands of years.

Introduction

Most churches have, or have had, one or more yew trees in their churchyards. Some of these are very large, and their spreading branches and hollow trunks give the impression of great age. Some have been supposed to be thousands of years old (Chetan and Brueton 1994, Bevan-Jones 2002). However, it is difficult to confirm these supposed ages. Trees do not grow at a constant rate throughout their life (Rackham 1986). Large yews are often hollow and therefore taking a core of the tree and counting the annual growth rings is not possible as the inner parts of the tree are no longer present.

Following the discovery in the Croydon Natural History and Scientific Society library of a set of measurements of churchyard yew trees in east Surrey in 1880 (Straker 1880), Gwyneth Fookes measured the same trees in 1994 (Fookes 1996). These trees provide data which can be used to estimate growth rates and ages.

Measurement of the trees

Yew trees in churchyards have the advantage that it can be certain that the same tree is measured on each occasion, and that trees of a wide range of sizes are included. The trunks were measured at five feet (152 cm) from the ground where possible. It is not possible to tell how much error is introduced from differences in the measurement method between 1880 and 1994. Yew trees are difficult to measure accurately because of ribs, twigs arising from the trunk and branches originating at low levels, and because large trees are often split and hollow.

Measurements for additional trees, outside the Bourne Society area (the southern part of the London Borough of Croydon and the eastern part of Surrey) are included in this paper. All measurements have been converted from inches to centimetres.

Results and discussion

Plotting the increase in circumference between 1880 and 1994 shows that, although the results are rather scattered, large trees generally grow more slowly than small ones (Figure 1). The best relation between the results is given by a

logarithmic equation (calculated using the Regression function in Microsoft Excel). Plotting the results as a logarithmic graph gives a linear relation, which is amenable to simple statistical treatment (Figure 2). Although the regression coefficient (r squared) is only 0.299, the rarity of a set of data like this means it is worth consideration. Plotting the 95 per cent confidence intervals, the upper and lower lines in Figure 2, (Stephens 1998) shows the wide variation of the results. The variation is caused by real differences between the trees and measurement errors.

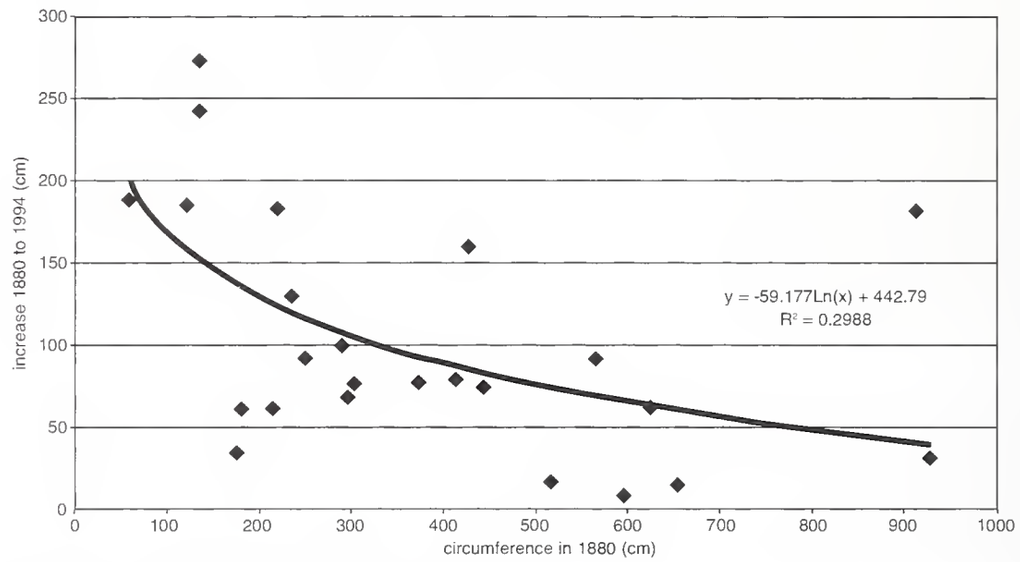

FIGURE 1. Growth of yew trees.

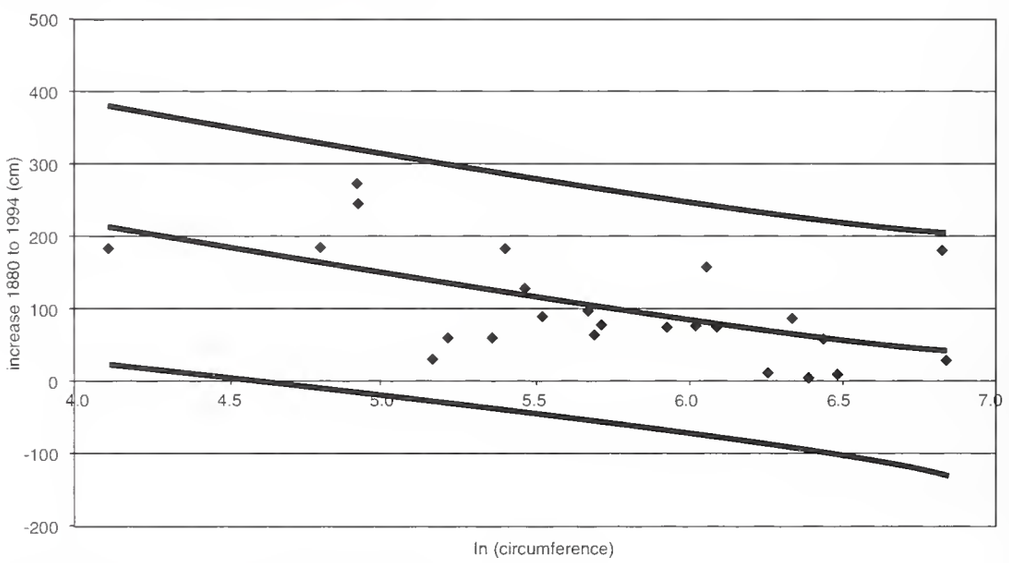

FIGURE 2. Growth of yew trees.

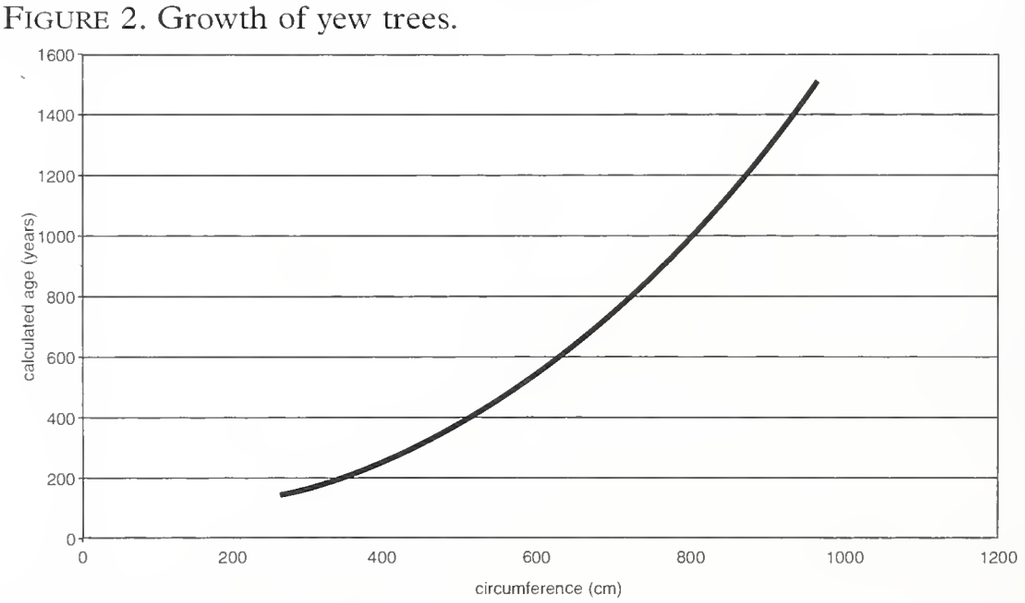

FIGURE 3. Calculated age.

The expected circumferential growth between 1880 and 1994, and the expected circumference in 1994 were calculated from the regression line (Table 2). The growth rate per year, the number of years since an average tree was the size of the next smallest in the row above in the table, and the estimated age were then calculated. Plotting estimated age against the circumference gives a graph from which estimated age can be read off from the circumference of the tree (Figure 3). It must be emphasized again that, because of the variation in the results, this estimate of age is approximate.

These calculations have made the assumptions that growth rate is constant within each size class, and that the growth rate of the first size class could be extrapolated backwards to the tree's origin. Errors attributable to these assumptions are likely to be small in relation to the variation within the data.

The results show that yews grow quite rapidly when young, with a gradually slowing growth rate with age. The calculated growth rates of these trees are comparable with those of most other trees. Rackham (pers. comm. quoted in Fookes (1996)) believes that in favourable conditions, yews (and other trees) grow at up to approximately three-quarters of an inch (1.9 cm) a year in circumference, and that the rate of growth decreases with age. These results are compatible with this view.

The very large yews could be in excess of 1,000 years old. However, it is likely that the age of very large yews can be easily over-estimated. Large yews are often hollow, and seem to lean outwards. Their trunks are covered with ribs and buttresses; they are often covered with twiggy outgrowths from the trunk; and the branches arise at quite low levels. Some trees are multi-stemmed: an 1828 painting of the Tandridge yew shows it to be multi-stemmed (Fookes, 1996), although now it appears to be one trunk. All these factors will increase the measured circumference, and these trees may not be as old as they seem. Large trees seem very variable in growth rate; our two largest trees, at Tandridge and Crowhurst, grew 183 and 30 cm respectively in circumference in 114 years.

Fookes (1996) also measured yew trees in six Victorian churchyards (churches built between 1860 and 1878) and in two old churchyards where no trees were recorded by Straker. These trees measured between eighty-four and 141 cm in circumference. Reading from the graph, extrapolated back to a tree of age zero and circumference zero, these trees are approximately 60 to 100 years old. Considering the variation in the results, this is compatible with these trees being planted when the churches were built.

Yew trees are far from immortal. Of the twenty-seven trees measured by Straker and revisited in 1994 (Fookes 1996), eleven (40 per cent) have gone. Yews are vulnerable to storms. The tree in Chipstead churchyard, which was measured by Straker in 1880, blew down in 1987 (Charles Pringle, pers. comm.), as did the famous tree in Selborne in Hampshire in 1990 (Bevan-Jones 2002).

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TABLE 1. Measurements of churchyard yew trees.

Village	Church	Grid reference	State of tree in 1994	Circumference in 1880 (cm)	Circumference in 1994 (cm)
Banstead	All Saints	TQ255596	Whole	61	249
Coulsdon	St John	TQ312582	Whole	122	307
Chelsham 3	St Leonard	TQ388591	Whole	137	381
Nutfield	St Peter & St Paul	TQ309509	Whole	137	411
Cheam	St Dunstan	TQ243639	Whole	175	208
Chelsham 1	St Leonard	TQ388591	Whole	183	244
Bletchingley	St Mary	TQ327508	Hollow	213	274
Chelsham 2	St Leonard	TQ388591	Whole	221	404
Warlingham 2	All Saints	TQ356589	Whole	236	366
Chaldon	St Peter & St Paul	TQ308558	Whole	251	343
Walton on the Hill	St Peter	TQ224551	Centre gone	290	389
Burstow 2	St Bartholomew	TQ313413	Hollow	297	366
Beddington	St Mary	TQ295652	Whole	305	381
Sanderstead	All Saints	TQ341615	Whole	373	450
Burstow 1	St Bartholomew	TQ313413	Hollow	411	490
Woldingham	St Agatha	TQ371549	Partly hollow	427	587
Capel	St John the Baptist	TQ175408	Hollow	442	516
Warlingham 3	All Saints	TQ356589	Whole	518	533
Addington	St Mary the Blessed Virgin	TQ371640	Hollow, quarter broken away	564	655
Farleigh	St Mary	TQ372601	Whole	594	602
Warlingham 1	All Saints	TQ356589	Hollow	625	686
Charlwood	St Nicholas	TQ240411	Hollow	653	665
Tandridge	St Peter	TQ374511	Hollow	914	1097
Crowhurst	St George	TQ391474	Hollow	930	960

TABLE 2. Estimation of growth rates and ages.

	circumference in 1880 cm	circumference in 1994 cm	growth in 114 years cm	Ln (1880 circumference)	expected growth 1880 to 1994 cm	expected circumference in 1994 cm	growth per year cm	years since previous size class	estimated age years
Banstead	61	249	188	4.110	200	261	1.75	149	149
Coulsdon	122	307	185	4.803	159	280	1.39	14	163
Chelsham 3	137	381	244	4.921	152	289	1.33	6	169
Nutfield	137	411	274	4.921	152	289	1.33	0	169
Cheam	175	208	33	5.166	137	312	1.20	20	189
Chelsham 1	183	244	61	5.209	135	317	1.18	4	193
Bletchingley	213	274	61	5.363	125	339	1.10	19	213
Chelsham 2	221	404	183	5.398	123	344	1.08	5	218
Warlingham 2	236	366	130	5.465	119	356	1.05	11	229
Chaldon	251	343	91	5.527	116	367	1.01	11	240
Walton on the Hill	290	389	99	5.668	107	397	0.94	32	272
Burstow 2	297	366	69	5.694	106	403	0.93	7	278
Beddington	305	381	76	5.720	104	409	0.92	7	285
Sanderstead	373	450	76	5.923	92	466	0.81	70	355
Burstow 1	411	490	79	6.020	87	498	0.76	43	397
Woldingham	427	587	160	6.056	84	511	0.74	18	415
Capel	442	516	74	6.091	82	524	0.72	18	433
Warlingham 3	518	533	15	6.250	73	591	0.64	104	538
Addington	564	655	91	6.335	68	632	0.60	68	606
Farleigh	594	602	8	6.387	65	659	0.57	48	654
Warlingham 1	625	686	61	6.437	62	687	0.54	51	705
Charlwood	653	665	13	6.481	59	712	0.52	49	754
Tandridge	914	1097	183	6.818	39	954	0.34	701	1455
Crowhurst	930	960	30	6.835	38	968	0.34	42	1497

Book review

Wildlife walks around the Cuckmere Valley. Patrick Coulcher. SB Publications, Seaford. 2002. 102 pp., 8 coloured plates. £7.95 paperback. ISBN 1 85770 247 6.

In this paperback, Patrick Coulcher has provided a series of guided walks to accompany his earlier book on the Cuckmere Valley[1]. Ten walks are highlighted from the coast at the Seven Sisters, to the more inland Downs above by Alfriston and then further inland to the woodland around Abbotts Wood and Arlington. I had known the coastal walks but as a test I tried the Abbotts Wood walk. This was on a summer evening – prior to a nightjar watch – and I did enjoy the stroll and correctly found my target species of spiked rampion as stated on pages 78 and 80.

In the review of Patrick Coulcher's last book on the South Downs (*LN* No. 80: 28 2001) I said I had enjoyed his earlier book on the Cuckmere and I consider this set of guided walks to be very useful. Often on going to new places, you know or suspect you are missing things — this guide has already been helpful in providing a more relaxed approach! If you are going to be in this delightful area of the South Downs, I would recommend this guide.

MICHAEL WILSDON

[1] *A natural history of the Cuckmere Valley*, The Book Guild. 1997.

Greater London as an arboretum — a guide to its rare trees

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Summary

Over two hundred rare tree species, subspecies, varieties, hybrids and cultivars, apart from the notable collection at Kew, have recently been recorded throughout Greater London and are listed. Some are the finest specimens of their kind in Britain. A few are the sole examples known in this country outside scientific collections. Other represent globally endangered species.

Their success here is largely due to London's temperate climate, enhanced by the urban heat factor. Global warming is introducing further possibilities.

Apart from historic collections such as the Chelsea Physic Garden and Syon Park, many rare trees are scattered throughout public parks which were once the private grounds of connoisseur collectors. Others are in the royal and metropolitan parks, in cemeteries, in streets, and at solitary sites.

Many of these rare specimens are old, and losses are gradually eroding this unique heritage. The genus *Crataegus* hawthorn is cited as an example of the threat to species diversity.

Greater London as an arboretum

The word 'arboretum' was first used in an English publication by tree enthusiast John Claudius Loudon (1838), in his *Arboretum et fruticetum*, an English language work despite the Latin title. The relevant extract, shown in the *Oxford English Dictionary*, is as follows: 'Collecting trees from a distance . . . to assemble them in one plantation or arboretum'.

The London Arboretum is unusually spacious, extending into most Greater London boroughs, but scattered through it is a rich assortment of 'trees from a distance'. The following list indicates the locations of a large selection, which can be found with the aid of a street atlas. All are accessible (subject to local conditions) or visible from public thoroughfares, and dimensions of many of them are shown.

Trees from world-wide

London's climate and other conditions are now well recognized as favourable to growth of exotic trees, but it was only during the seventeenth century that this

began to be demonstrated. Trade routes to all parts of the globe were then opening up, bringing boundless possibilities for early British plant hunters, such as the Tradescants father and son. Some were financed by wealthy landowners, who competed for new species to adorn their estates. Henry Compton (1632–1713), Bishop of London and an enthusiastic gardener, was able to get his clergy in the new colony of Virginia to send seeds from America. Before long, soldiers and diplomats, traders, doctors and missionaries all over the world were participating in this treasure hunting.

At home, in 1664 John Evelyn published his great work *Sylva; a discourse of forest trees* and is considered to have originated the movement to plant ornamental trees and woodlands. The Chelsea Physic Garden was established in 1673 by the Society of Apothecaries — its tree collection today includes rare species of medicinal benefit, in particular those scarce in the wild. In 1687 Brompton Park became the first of a series of notable London nurseries, which over the following two centuries propagated and distributed exotic species.

Ships brought an ever-increasing flow of travellers and their finds to London, where scientists and gardeners avidly awaited new discoveries. Among them were Peter Collinson (1694–1768), who had a famous garden at Mill Hill. In January 1835 Loudon (1838) visited the site and noted a *Platanus* forty feet high and of eighteen inches diameter at one foot from ground level. Could this be the *Platanus orientalis* on the lawn of what is now Mill Hill School, which was measured in 2001 as 18 metres high and of 106 cm in diameter?

Another was Dr John Fothergill (1712–1780), whose property, now West Ham Park, was said to rival the Royal Botanic Gardens at Kew. Employing collectors and using the services of sea captains, he amassed a huge collection of rarities, which were painted by a team of artists. On his death these works were acquired by Catherine the Great of Russia, then creating for her son Paul the magnificent palace and park of Pavlovsk near St Petersburg. One of Britain's first *Ginkgo biloba* was planted in West Ham in 1763, and is one of the few identifiable relics of Fothergill's garden still to be seen there. It would be appropriate if an example of *Buxus balearica,* a rare box which he introduced, could be restored to the site.

Cemeteries and parks

From the late eighteenth century, for about a hundred years, wealthy London residents created lavishly landscaped private grounds around their mansions. The less privileged probably got their first sight of rare trees in one of the new cemeteries, created in the interests of health and hygiene by the early Victorians. Between 1832 and 1841 seven spacious burial grounds were established on the city's fringes, and were laid out in park-like fashion. Abney, benefiting from its proximity to Loddiges' famous Hackney nursery, 'contained one of the most complete arboretums in the neighbourhood of London, all the trees and shrubs being named' (Loudon 1843). Long ago filled to overflowing with burials, Abney is now a nature reserve. A few ancient trees survive.

The establishment of purpose-made recreational parks soon followed, starting with Victoria (1845) and followed by Battersea (1858). These were planned in grandiose fashion by the architect James Pennethorne and planted under the direction of John Gibson. Gibson had trained at Chatsworth, Derbyshire, seat of the Duke of Devonshire, one of the finest properties in England. Now his task was to create elegant landscapes on cleared-slum London sites, and to bring beautiful trees, shrubs and flowers, avenues and vistas, lakes and lawns, within reach of all. It is good to know that Gibson's plans underlie the current restoration of a large section of Battersea Park. How this master of sub-tropical gardening would relish today's urban heat island effect and global warming.

In 1856, a nursery was established at Kew for the supply of trees (at first mainly elms and planes) to the royal and metropolitan parks. Then in 1860 William Cowper, First Commissioner of Works, ordered diversification into a

wide range of introduced species (Wiltshire 2002). The effects of this policy survive to the present day in several of the central parks, where rare old trees may still be found (Figure 1). These parks are ideal sites for such exotic plantings, which please the public, intrigue specialists, and add distinction to London as a whole. A welcome recent introduction is the rare *Aesculus glabra* Ohio buckeye near Hyde Park Lido (Figure 2).

Private retreats become public amenities

Around the end of the nineteenth century, encroachment by the fast-growing city led to disposal of many private estates, and elegantly landscaped gardens became transformed into public parks. These included Brockwell (1892), East Ham Central (1896), Clissold (1889), Downhills (1902), Gladstone (1898), Mountsfield (1905), Ravenscourt (1887), Ruskin (1907), Springfield (1905), and Waterlow (1888). As it is now about a century or more since these properties came into public ownership, few vestiges, other than occasional rare old trees, survive from their former status.

After the First and Second World Wars a further swathe of private estates became public parks, including Belair (1947), Cannizaro (1947), Charlton (1925), Chiswick (1929), Eltham Palace (1944), Fulham Palace (1975), Gunnersbury (1925), Holland Park (1952), Montpelier (1955), and Woodcock (1951). Although public acquisition of some was relatively recent compared to the earlier batch, several were already in a run-down state by the time they were handed over. Once again, the clearest evidence of choice planting lies mainly in surviving rare trees, and until recent times there has been little replanting of such specimens. A conspicuous exception is Cannizaro Park at Wimbledon, where a superb collection of trees and shrubs is well maintained.

The remnants of these former private gardens, created over a period of some three centuries, still reflect something of the diverse tastes, interests and resources of their former owners, and impart a unique quality to the London Arboretum.

The period 1860–1900 brought many innovations but was followed by almost a century of decline, so losses of rare trees are accelerating. Recent casualties include Holland Park's *Hovenia dulcis* Japanese raisin tree, and *Populus yunnanensis* in Kensington Gardens. Other species appear to be more secure since several specimens survive, for example *Acer monspessulanum* Montpelier maple and *Fraxinus angustifolia* 'Veltheimii', but all are ageing and are almost the only British examples of their kind.

Even more critically, several species found here are globally threatened. These include *Abies numidica*, which is restricted to Mount Babor in Algeria, and *Pinus canariensis*, restricted to the Canary Islands. Others are *Sciadopitys verticillata* umbrella pine from north Japanese mountains, the subject of a breeding programme for genetic diversity in Britain, and *Eucalyptus mitchelliana*, which is very restricted in the wild.

Hawthorns

The extent of species diversity loss throughout London is illustrated by the fate of once-fashionable *Crataegus* hawthorns.

There are at least 200 species of *Crataegus* hawthorn. All are floriferous; many also carry showy fruits, and most are singularly tough small trees which thrive on sticky clay. This should make them ideal for planting in London, but they are one of the few genera which are cultivated in less diversity than a century ago. Field guides and books on gardening have to date almost completely ignored them. Kew has a collection of about forty taxa; a considerable variety of often moribund trees also lurks unrecognised in many of the city's parks and cemeteries.

Of the two native species, *Crataegus laevigata* Midland thorn has been the more prolific of varieties. The double red 'Paul's Scarlet' is abundant, with the

softer pink 'Rosea Flore Pleno' also appearing widespread. Rarer are the double light pink 'Masekii' (Osterley Park, Waterlow Park), the double white 'Plena' (Gladstone Park, Osterley Park, Golders Green Crematorium and Watling Park, Burnt Oak), the single red 'Punicea' (St Andrew's churchyard in Holborn, Avenue House, Waterlow Park and Queen's Park at Kensal Rise). The erect *C. monogyna* 'Stricta' is still widely planted; a few old trees are probably the less than spectacular weeping clone 'Pendula' (St James's Park, Buckingham Palace, Barkingside Recreation Ground and Goresbrook Park, Dagenham).

With its large red haws and grey-downy leaves, the east Mediterranean *Crataegus laciniata* is still sometimes grown. There are small trees in St James's Park (by The Mall), Richmond Park (Ham Gate), Clissold Park, Boston Manor Park, Princes Gardens, South Kensington, and Battersea Park (south-west, behind toilets). Closely related but perhaps prettier is *C. tanacetifolia* (City of Westminster Cemetery, Hanwell). Also from southern Europe and with downy foliage, *C. azarolus* azarole has long been grown here for its sweet fruit, but is now almost extinct; one small tree is in the Chelsea Physic Garden. A smaller-fruited tree in the Springfield Gardens, Acton, seems to be the Grecian *C. heldreichii.*

Some east European thorns have black haws. One in the City of Westminster Cemetery, Hanwell is probably *Crataegus oliveriana*, while an old *C. nigra* Hungarian thorn, in the Greenwich Park Flower Garden is also notable for its big leaves. Similar but from central Asia is *C. dsungarica* in the City of Westminster Cemetery collection at Hanwell. From China, *C. pinnatifida* carries leaves shaped like common hawthorn's, but up to 15 cm long. There are impressive old trees in Clissold Park, Norbury Park, Pymmes Park, Maryon Park (Charlton), Myatt's Fields Park, Waterlow Park (moribund by 2002), the City of Westminster Cemetery at Hanwell, and in a front garden in Belsize Gardens, Belsize Park.

The majority of *Crataegus* are North American. The 'red haws', with large, shallowly-lobed leaves and big crimson fruit, are particularly hard to separate. The London population (at least twenty-five trees, excluding Kew's) seems to include *C. chrysocarpa*, *C. coccinioides*, *C. ellwangeriana* (perhaps the least 'rare'), *C. mollis*, *C. pedicellata* and *C. submollis*. The cockspur thorns, with unlobed leaves, are represented abundantly by 'Prunifolia' and the vigorous hybrid × *lavallei*. Similar to × *lavallei* but much less planted is *C.* × *grignonensis*, whose red fruit at Christmas time are still set off by blackish-green leaves. There are small trees at Campbell Court, Gloucester Road, and Kingswood House, Bromley.

Crataegus punctata is a strong-growing American thorn with white-dotted fruit and unlobed leaves. Trees in London parks would seem to comprise much of the UK population. The largest are two much-loved trees on Hampstead Heath, with gnarled, twisted trunks and wide, tabular branches (west side of the Highgate Ponds, and by the cafeteria south-east of Parliament Hill). Others are in Camberwell New Cemetery, the Greenwich Park Flower Gardens, Maryon Park and Maryon Wilson Park at Charlton (six trees), St Ann's Hospital in Haringey and Tooting Graveney Common (a group by Dr Johnson's Avenue). A putative hybrid with *C. tanacetifolia*, *C.* × *dippeliana*, also makes a picturesque old tree (Ranelagh Gardens and Southgate Cemetery, Arnos Grove). Another old thorn in the Pembroke Lodge garden, Richmond Park, is *C. flabellata*. *C. phaenopyrum*, the Washington thorn, is particularly garden-worthy and remains small; one is by the Maple Avenue in Cannizaro Park.

Another tree which should be mentioned here is × *Crataemespilus grandiflora*, the sexual hybrid between *Crataegus laevigata* and *Mespilus germanica* medlar. Absent from most tree guides, it too occurs as an old tree in several London parks (Archbishop Park, Lambeth; Green Park (Constitution Hill side); Maryon Park and Maryon Wilson Park in Charlton, Ravenscourt Park (by railway bridge) and Victoria Park, Hackney (Skew Bridge edge). A 1973 tree in the Chelsea Physic Garden has grown surprisingly fast; there are mature street trees in Marnham Crescent, Greenford.

The urban heat island

Through the second half of the twentieth century, ubiquitous central heating and internal combustion engines began to raise the average temperature inside large cities by up to three degrees centigrade. Tarmac and masonry also retain heat, radiating it slowly through the night. Within London, as a result, severe frosts have almost ceased, summers have grown hotter, with an increase in thundery rainfall, and the growing season has become at least a week longer. These factors benefit the growth of almost all kinds of tree, and are particularly interesting as they represent a microcosm of the possible effects of global warming on tree health across Britain as a whole during the next few decades.

London has always been in the warmest corner of Britain, and this is reflected in the growth of heat-loving trees such as planes and weeping willows. *Ficus* fig and *Laurus* bay, bushy across most of the country, have produced Britain's largest examples here (Chancery Lane and Lansdowne Crescent, Notting Hill, respectively); other heat-loving trees which have grown largest here include *Catalpa bignonioides* Indian bean (Palace Yard, Westminster, and the Inner Temple Garden), *Quercus palustris* pin oak (Hyde Park and Mill Hill School), *Gleditsia triacanthos* honey locust (Tooting Bec Common), *Prunus dulcis* almond (Hammersmith Cemetery, Fulham) and *Populus alba* 'Pyramidalis' Bolle's poplar (Sydenham Wells Park). Even species which will survive happily in Scotland tend to grow faster the warmer the temperature, and London's parks have a remarkable concentration of Champion Trees (the largest known examples in Britain or Ireland).

The survival of tender trees is a more recent phenomenon, and only fast-growing *Eucalyptus* are so far making an impact on the urban scene. Some beautiful but still rare species include *E. cordata* by the old bowling green at Ruskin Park, the long-leaved *E. nitens* (Syon Park behind Flora, and Pitshanger Park, Ealing), and the very white-barked *E. viminalis* (Inwood Park, Hounslow, and the Norman Leddy Memorial Garden, Hayes, Middlesex).

Recently, *Phoenix canariensis* Canary palm, *Dicksonia antarctica* common tree-fern, and *Eriobotrya japonica* loquat, have begun to proliferate, with *Albizia julibrissin* pink siris being tried as street trees. *Grevillea robusta* silk oak, from Western Australia, is an unlikely but so far successful survivor by the pavement in Lower Street, Rotherhithe (Figure 3). *Pittosporum tenuifolium* 'Variegatum' silver kohuhu has made a luxuriant nine-metre plant in the Paddington Road Gardens, Marylebone. *Acacia dealbata* mimosa is a popular plant which can be cut to the ground by a few degrees of frost but quickly makes a substantial tree; one in Montpelier Road, Ealing, has reached 15 metres.

More exclusive to mild areas is *A. melanoxylon* blackwood acacia, but the multi-stemmed nine-metre tree at Forty Hall, Enfield, owes its survival to its location against a south-facing courtyard wall, since the effects of the heat island must be minimal this close to open countryside. *Cupressus cashmeriana* Kashmir cypress has survived to make a small tree in the Greenwich Park Flower Garden, though this is no beauty in comparison with the tree inside the Temperate House at Kew.

Olea europaea olive is one of a great range of trees which demand both mild winters and hot summers. These conditions have tended to be mutually exclusive in Britain, and the olive in the Chelsea Physic Garden is the only substantial tree known; there are young plantings in Gladstone Park, Hyde Park Square, Connaught Square and Sunray Gardens SE24. Other warm-temperate trees successfully growing in the Physic Garden include *Araucaria angustifolia* Parana pine from Brazil, *Luma apiculata* Chilean myrtle, and *Pinus canariensis* Canary Island pine. Seedlings of *Koelreuteria paniculata* golden rain tree, a native of hot dry conditions in the Far East, were observed during 2001 on rail tracks at South Kensington and West Brompton stations (Burton 2002). A fine *Persea*

FIGURE 1. *Gleditsia triacanthos* honey-locust, a spiny-barked veteran in Victoria Park, Hackney, 22 April 2003.

FIGURE 2. *Aesculus glabra* Ohio buckeye near the Lido in Hyde Park, May 2003.

FIGURE 3. *Grevillea robusta* silk oak from Western Australia, flourishing in Rotherhithe SE16, 24 March 2003.

FIGURE 4. *Persea americana* avocado from Central America at a sheltered site in Chelsea, May 2003.

Photos: Elinor Wiltshire

FIGURE 5. *Zelkova sinica* Chinese zelkova on Old Oak Common near Wormwood Scrubs prison, 16 November 2003.

FIGURE 6. *Aesculus* × *mutabilis,* rare hybrid horse chestnut, close to Sloane Square, May 2003.

FIGURE 7. *Lyonothamnus floribundus* spp. *asplenifolius* from Californian islands, as a street tree near the King's Road, Chelsea, May 2003.

FIGURE 8. *Quercus libani* Lebanon oak as a street tree near Westbourne Green, Paddington, September 2003.

Photos: Elinor Wiltshire

americana avocado grows up the front of a house in St Leonard's Terrace, Chelsea (Figure 4), and close to it is a *Melia azedarach* bead tree, more familiar by the Mediterranean.

In addition to all the above, there must be a wealth of unusual trees tucked away in London's private gardens. With climate change, the range of exciting plants which could be tried is tremendous.

Conclusion

London's unique suitability as a site for rare trees from all parts of the world has been recognized for four centuries. Generations of enthusiasts have contributed to the city's rich heritage, particularly during the eighteenth and nineteenth centuries.

Then, for a variety of reasons, the twentieth century saw a decline in the planting here of rare species. However, local authorities have from time to time planted rarities in available green spaces, such as the 1960s *Zelkova sinica* on Old Oak Common (Figure 5), or in favoured street-side sites. Among the latter are the hybrid horse chestnut *Aesculus* × *mutabilis* near Sloane Square (Figure 6)and the Californian *Lyonothamnus floribundus* ssp.*aspleniifolius* just off Kings Road, Chelsea (Figure 7).

There is now a fresh enthusiasm for greenery in London. Parks are being refurbished, streets lined with trees, and open spaces beautified. There are new opportunities for planting rare and notable trees, even as solitary specimens. In years to come they will add distinction to their locality, and embellish London as whole.

Special features of the London Arboretum have been noted and recorded by several observers. Angus Duncan Webster (*c.*1850s–1920s), after twenty-five years as superintendent in the Royal Parks, published *London trees* (1920). In this he describes trees of note, for the most part within a radius of eight miles of Charing Cross. A wealth of species grew even in this congested area, often in conditions of suffocating air pollution. Maynard Greville, who did extensive recording of trees throughout Britain during the 1950s, compiled details of a number of notable London trees. Alan Mitchell (1922–1995), in the course of a career with the Forestry Commission, supplemented his records of timber conifers with thousands of measurements of other notable trees, including those in a number of London parks. In 1988 he established The Tree Register to act as a repository for his accumulated records. Peter Bourne, a Tree Register volunteer with a particular interest in *Ulmus*, was the first person to measure the trees in many of London's parks, cemeteries and woodlands during the mid-1990s.

The following list of over two hundred species, subspecies, varieties, hybrids and cultivars indicates the range of rare trees currently to be found throughout Greater London. It was compiled mainly by Owen Johnson, in association with The Tree Register, during the 2001 and 2002 seasons. Although very wide-ranging and detailed, it is not a complete inventory of rare trees in the public domain. There may be many other mature specimens, and certainly unusual young trees are now being introduced at a number of sites. It is hoped that publication of this list will draw attention to these and other rare species throughout the London Arboretum.

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Rare tree species in Greater London

Dimensions: height in metres and girth in cm at 1.5 m, unless otherwise indicated. Where there are several specimens on site, dimensions of the largest are given. C indicates first recorded date of cultivation.

Champion trees are the best examples of the species in Britain.

Trees were recorded in 2001–3, unless otherwise indicated.

Nomenclature, authorities, dates of introduction, etc. are based on Bean (1970–1988), Hillier Nurseries (2002), Krüssmann (1984–1986) and Mitchell (1994).

CONIFERS

Abies alba European silver fir. C 1603. Shooters Hill, SW from Castlewood House Gardens, near top of hill. Old tree, estimated 18 × 142. Rare in eastern England.

Abies concolor Colorado white fir. W USA 1873. Osterley Park Pinetum. Good narrowly columnar tree 25 × 205.

Abies forrestii. China, Tibet 1910. Syon Park, E from Flora's Lawn, stunted, craggy bark but glabrous shoot 7 × 89. Rare in East.

Abies numidica Algerian fir. 1861. Hendon Park, NW entrance, ivy 11 × 94.

Araucaria angustifolia. Chelsea Physic Garden, SE quarter no. 119, planted *c.* 1983, 5 × 38. Scarcely tried in England.

Cedrus atlantica 'Aurea' Atlantic cedar. C 1900. Osterley Park Great Meadow, near house 13 × 205.

Cephalotaxus fortunei Chinese plum yew. China 1849. Morden, Ravensbury Park.

Cephalotaxus harringtonii 'Fastigiata'. Golders Hill Park.

Cunninghamia lanceolata Chinese fir. China, Vietnam 1804. Cannizaro Park, heather garden on left of downhill path from Retreat; Chiswick Park 13 × 114. Rare in SE.

× *Cuprocyparis* [× *Cupressocyparis*] *notabilis*. Holland Park, E end of formal gardens 6 × 38.

Cupressus arizonica var. *arizonica* Arizona cypress. SW USA, N Mexico. Gunnersbury Park, S of Museum 12 × 124.

Cupressus arizonica var. *glabra* 'Aurea'. Australia C 1957. Inner Temple Garden, W side 8 × 68 and 8 × 63.

Cupressus cashmeriana weeping cypress of Bhutan. 1862. Greenwich Park in the Flower Gardens, W of lake, healthy though no beauty 9 × 91. Otherwise found out of doors only in the mildest parts of England.

Cupressus lusitanica 'Glauca pendula'. C 1925. New Southgate Cemetery, two good young trees by Shoghi Effendi Memorial 8 × 66.

Picea brachytyla. China 1901. Danson Park Formal Gardens 8 × 63. Very rare in SE.

Picea glauca white spruce. Canada, NE USA 1700. Bushy Park, Waterhouse Woodland Gardens, pine group, S edge, largest 12 × 78; Lamorbey Park, The Glade lakeside17 × 107. Rare in SE.

Pinus bungeana lace-bark pine. China 1846. Purley Oaks, Wettern Tree Garden, 8 × 59, 7 × 55 (seed collected 1925).

Pinus canariensis Canary Island pine. Chelsea Physic Garden, Swan Walk edge 4 × 20. Very rare.

Pinus cembra Arolla pine. S & E Europe C 1746. Osterley Park Pinetum 15 × 155; Purley Oaks, Wettern Tree Garden 13 × 71.

Pinus coulteri big-cone pine. California 1832. Bushy Park, Waterhouse Woodland Gardens, pine group, mid N 17 × 193; Cannizaro Park near Retreat; Hanger Hill Park SW, very young, 5 × 56.

Pinus densiflora Japanese red pine. 1852. Danson Park, Formal Gardens, one half cut 5 × 101 at1.3 m; Jewish Cemetery, Brady Street, Whitechapel.

Pinus densiflora 'Umbraculifera'. C 1890. Syon Park, rockery W of Flora's Lawn, larger of pair 9 × 91 at 1.3 m. Champion.

Pinus halepensis Aleppo pine. C 1683. Mediterranean, W Asia. Richmond Terrace Gardens, top; slender tree labelled 'P. peuce' 16 × 106. Rather rare.

Pinus jeffreyi Jeffrey pine. 1852 SW USA. Mill Hill Park, NE 9 × 208; Pinner Memorial Park by Community Centre 20 × 172. Very patchy in England.

Pinus nigra ssp. *salzmannii* Pyrenean pine. 1835. Syon Park, SE from Flora's Lawn, very dense dome 14 × 292.

Pinus patula Mexican pine. pre-1837. Danson Park, Formal Gardens NW, 4 m; Hall Place, Bexley, Main Garden, S by river, 2 m.

Pinus peuce Macedonian pine. 1864. Hall Place, Bexley, Main Garden 13 × 142. Rare in SE.

Pinus torreyana Torrey pine. California 1853. Chelsea Physic Garden, pond. 4 × 25. Very rare.

Prumnopitys andina plum-fruited yew. Andes 1860. Finchley Avenue House; Hadley Wood, Beale Arboretum (West Lodge Park). Uncommon in East.

Pseudolarix amabilis golden larch. China 1852. Cannizaro Park; Chelsea Physic Garden, no. 60; Richmond Park Isabella Plantation 1996.

Sciadopitys verticillata umbrella pine. Japan 1861. Cannizaro Park, behind Birdhouse; Golders Hill Park; Kelsey Park, Beckenham, E edge 8 × 73.

Sequoia sempervirens 'Adpressa' California redwood. C 1867. Heathfield House, Addington Drive, by house 10 × 104. Rather rare.

Taxodium distichum var. *imbricatum.* Cleary Gardens, Huggin Hill, Queen Victoria Street, planted 1975; Holland Park Belvedere terrace 13 × 116; Syon Park; 'Nutans' Hadley Wood, Beale Arboretum (West Lodge Park) 15 m.

BROADLEAVES

Acacia melanoxylon. S Australia, Tasmania 1808. Forty Hall, S wall by house, sinuous stems regrowing 9 × 61. Only 'tree' in SE?

Acer buergerianum trident maple. China, Korea 1890. Hadley Wood, Beale Arboretum (West Lodge Park) 1998; Imperial War Museum, Tibetan Peace Garden.

Acer carpinifolium hornbeam maple. Japan 1879. Cannizaro Park no. 56, W of Maple Avenue, W arm; Syon Park, small.

Acer cissifolium. Japan pre-1870. Cannizaro Park N edge of main lawn, near house, 9 × 81.

Acer diabolicum horned maple. Japan 1880. Syon Park 3 trees in compartment 2-60, 10 × 160 at 1.2m, 9 × 139 at 1.3m, 8 × 132.

Acer heldreichii. SE Europe 1879. Syon Park N of E end of lake, some dieback, 11 × 104.

Acer maximowiczianum Nikko maple. Japan, China 1881. Cannizaro Park, N of house, E side 14 × 142 at 0.2 m; City of Westminster Cemetery, Hanwell NW no. 137 8 × 86; Greenwich Park, SE from lake, 6 × 60. Rather rare.

Acer monspessulanum Montpelier maple. S Europe, W Asia 1739. Burton's Court, opposite Chelsea Royal Hospital; Bushy Park, Waterhouse Woodland Gardens, E gate, N lawn, 16 × 205 Champion; Cannizaro Park, near top of lawn 1996, 10 × 149; Crane Park Whitton, back edge of lawn W of tower 12 × 163; Kensington Gardens by Queen Anne's Alcove 15 × 198 (Bean 1970, 1988); Manor Park Cemetery, Forest Gate, near entrance; Osterley Park Pleasure Gardens near Temple, old tree 9 × 160 at 1.2m; Pymmes Park SW 14 × 188; Ranelagh Gardens SE corner 8 × 132; West Ham, NE near glasshouses (Bean 1970) 12 × 223. Very few left outside London.

Acer obtusifolium. SW Asia, Cyprus *c.*1903. Kensington Gardens near Albert Memorial. Bushy collapsed old tree, still vigorous. Very rare.

Acer pentaphyllum. China 1937. St James's Park at Palace end in Azalea bed 2002. Very rare.

Acer sempervirens Cretan maple. E Mediterranean 1752. Syon Park N of lake, in border W of engine shed, hole through trunk at 1 m, 8 × 147 at 0.2 m.

Acer stachyophyllum. E Himalayas, W China 1901. City of Westminster Cemetery, Hanwell SW, W side, 8 × 50.

Acer trautvetteri. Caucasus, E Turkey 1866. Syon Park, SE of lake bridge, 12 × 152.

Acer triflorum rough-barked maple. Manchuria, Korea 1923. East Ham, Central Park.

Acer × *zoeschense*. C 1908. City of Westminster Cemetery, Hanwell mid NE 11 × 114; Manor House Gardens, Hither Green, mid W larger of pair 10 × 114; Syon Park, N of Flora 20 × 233 Champion; Carter Lane opposite St Paul's.

Aesculus californica. 1850. Battersea Park, two old trees on S side of Woodland Walk; Kennington Park, two old trees by side gate from Kennington Road; Ravenscourt Park, dog exercise enclosure 6 × 101.

Aesculus × *carnea* 'Plantierensis' red horse chestnut. France *c.*1894. Beckenham Southend Road, street trees by Abbey Park, largest 13 × 43; Crystal Palace Park, Sports Centre gates 1998, largest 9 × 91; Gladstone Park, S border, mid 10 × 165 at 1.2m. Nationally rare.

Aesculus 'Dallimorei'. Kensington Gardens 'Chestnut Quarter' W of Leafpen, several young trees.

Aesculus glabra Ohio buckeye. C 1809. Hyde Park, N of Lido carpark, young tree; Syon Park, mature tree by lake near entrance, 8 × 99 at 0.6 m. Figure 2.

Aesculus × *hybrida*. Abney Park Stoke Newington, E of chapel young tree by avenue; Hyde Park E of Magazine 20 × 192, 21 × 192 (Bean 1988 as '*A. flava*'); Kensington & Chelsea Cemetery Hanwell on E side of entrance avenue among *A. flava* 16 × 193; Regent's Park near St Katharine's Gate; Victoria Park Hackney 6 trees, 2 on W side by path E of lake, and 4 on E side N and NW of Burdett-Coutts memorial drinking fountain.

Aesculus × *mutabilis*. C 1834. Chelsea D'Oyley Street. Figure 6.

Aesculus parviflora bottlebrush buckeye. SE USA 1785. Holland Park Oak Enclosure.

Aesculus pavia red buckeye. S USA 1711. City of Westminster Cemetery Hanwell 331; Syon Park compartment 7.50.

Aesculus turbinata Japanese horse chestnut. Pre-1880. Hyde Park × 3 by Triangle carpark 41107, 41109, 14811.

Alnus firma Japanese green alder. 1894. Chelsea Physic Garden 113 Eastern quarter 8 × 40 at 0.8m.

Alnus glutinosa 'Pyramidalis'. Willesden Ambleside Road, street tree by Roundwood Road junction 11 × 81. Only 3 known.

Alnus incana 'Laciniata'. C 1861. Capel Manor, Enfield Water Garden 10 × 66; Regent's Park S of lake, nearest to path in group 13 × 142.

Alnus incana 'Pendula'. Pre-1900. Woodcock Park Kenton, N side SW 8 × 91.

Alnus orientalis oriental alder. E Mediterranean 1924. Woodcock Park, N side SW corner 10 × 111.

Alnus × *spaethii*. C 1908. Borough SE 1, young trees 5m high in Staple Street; Maida Vale, tree by canal footbridge, Blomfield Road; Purley young tree in Beech Avenue.

Alnus subcordata Caucasian alder. 1838. Hyde Park S Police House 20 × 205; St James's Park S side of lake 18 × 167.

Arbutus menziesii Madrona. British Columbia, California 1827. Cannizaro Park Lady Jane's Wood.

Betula albosinensis. China 1901. Cannizaro Park Birch Grove no.17.

Betula albosinensis var. *septentrionalis*. City of Westminster Cemetery Hanwell, mid 8 × 66.

Betula alleghaniensis. N America about 1767. Cannizaro Park upper valley 13 × 127 (labelled *Ostrya carpinifolia*).

Broussonetia papyrifera paper mulberry. E Asia early eighteenth century. Battersea Park; Cannizaro Park; Chelsea Physic Garden; Coram's Fields W edge.

Buxus balearica. Balearic Islands before 1780. Chelsea Physic Garden, Swan Walk edge S 6 × 70.

Carpinus orientalis. SE Europe, W Asia 1735. Chelsea Physic Garden NE Quarter no. 41; Syon Park Duke's Walk, by bamboos 14 × 116. Very rare.

Carya glabra pignut. N America 1799. Cannizaro Park Birch Grove 23 × 119.

Carya laciniosa big shellbark hickory. E USA 1804. Syon Park compartment 5.10, 19 × 129.

Castanea sativa 'Albomarginata' sweet chestnut. Golders Hill Park; Hall Place, Bexley Main Garden; Morden Hall Park, S of River Wandle; Osterley Park Great Meadow near house (reverted) 17 × 325 Champion.

Castanea sativa 'Heterophylla' ('Asplenifolia'). Syon Park N of Flora W 20 × 218.

Celtis australis southern nettle-tree. Mediterranean, SW Asia from sixteenth century. Avenue House Finchley, a small tree; Purley Oaks Wettern Tree Garden 14 × 147 (seed collected 1925); Ranelagh Gardens S edge 9 × 81; Syon Park, small.

Celtis occidentalis hackberry. N America 1656. Battersea Park two old trees NE and W edge; Cannizaro Park large old tree in Rose Garden 11 × 167; Woodcock Park 15 × 104 1996; Charlton Park Great Tree and Champion 16 × 208; City of Westminster Cemetery Hanwell no. 427; Barnes, The Green, opposite Nassau Road 4 × 40, 7 × 61; Syon Park Church Walk 10 × 83.

Cladrastis kentukea yellow-wood. SE USA 1812. Cannizaro Park walled garden no. 36; Fulham Palace Park 10 × 116; Hyde Park near Rose Garden 9 × 142; Syon Park.

Cladrastis sinensis Chinese yellow-wood. China 1901. Bushy Park Waterhouse Woodland Garden 10 × 66; Syon Park.

Crataegus azarolus azarole. N Africa, W Asia C 1620. Chelsea Physic Garden order beds/pond, 5 × 73 Champion. Almost extinct.

Crataegus × *dippeliana*. Garden origin C 1830. Ranelagh Gardens Chelsea, far SW 6 × 63; Southgate Cemetery Arnos Grove mid W 6 × 124 Champion.

Crataegus × *grignonensis*. Origin about 1873. Kingswood House Bromley N edge by road junction 4 × 78, in young planting; South Kensington Gloucester Road, Campbell Court front, corner by Queen's Gate Gardens 4 × 63; young trees along Daws Lane, Mill Hill.

Crataegus heldreichii. Springfield Gardens, Acton Horn Lane side, mid, downy foliage, dark red haws with one seed, 3.5 × 50. Very few.

Crataegus heterophylla. Crystal Palace Park Thicket Road boundary.

Crataegus nigra Hungarian thorn. 1819. Greenwich Park Flower Gardens N 6 × 142 Champion. Very few.

Crataegus persistens. Holland Park N edge of N Lawn 5 × 70.

Crataegus phaenopyrum Washington thorn. SE USA 1738. Cannizaro Park, S end Maple Avenue 4 × 33.

Crataegus pinnatifida. NE Asia C 1860. Clissold Park mid E, dying back, graft 1.3m 8 × 142 Champion, and 8 × 127; Norbury Park Norwood NW 5 × 57; Pymmes Park S of lake, mid, old limbs broken and new crown regrown, 9 × 137 Champion. Also (likely to be the var. major) 87 Belsize Gardens Hampstead *c.*8 × 100; City of Westminster Cemetery Hanwell mid S 6 × 63; Maryon Park S edge 8 × 132 at 1.3m; Myatt's Fields Park NE corner 5 × 78; Waterlow Park E borders 11 × 136 (dying).

Crataegus punctata. E N America 1746. Camberwell New Cemetery entrance 4 × 91; Greenwich Park Flower Garden 5 × 86; Hampstead Heath café by bandstand, SE of Parliament Hill 5 × 208 Champion; Maryon Park Charlton, NE from tennis courts 5 × 129; Maryon Park, Maryon Road entrance 8 × 119; Maryon Wilson Park, group of three just S of zoo 7 × 104; St Ann's Hospital, Haringey, fine trees with some die-back 8 × 190 at 1.2m; Tooting Graveney Common, group by Dr Johnson's Avenue N end, largest, largest 5 × 101. Nationally rare.

× *Crataemespilus grandiflora*. France C 1800. Archbishop Park Lambeth 8 × 96; Chelsea Physic Garden Swan Walk S 9 × 114; Dulwich Park Court Lane Gate SW; Green Park 9 × 116 at 11m; Greenford Marnham Crescent 6 × 85; Maryon Park Charlton, Woolwich Road entrance 4 × 72; Maryon Wilson Park, Charlton Valley 5 × 99; Ravenscourt Park SE N of railway bridge 7 × 129; Victoria Park, Skew Bridge edge 8 × 106; Waterlow Park NW edge 7 × 78.

Crinodendron patagua. Chile 1901. Chelsea Physic Garden Swan Walk gate 6 × 50.

Diospyros virginiana N American persimmon. 1629. Cannizaro Park Heather Garden; Purley Oaks Wettern Tree Garden 11 × 101, 10 × 97 at1.2m (seed collected 1925); Syon Park.

Drimys winteri Winter's bark Chile 1827. Bunhill Fields, in bad state; St Dunstan's-in-the-East; Cannizaro Park by gardener's cottage, walled garden; Golders Hill Park. Normally confined to SW Britain as a tree.

Ehretia dicksonii. Himalayas, Far East 1897. Chelsea Physic Garden NE Quarter no 24, planted 1986, 4 × 28. Very rare.

Eucalyptus archeri alpine cider gum. Tasmania. Hayes Middlesex (S of Cottage Hospital) Norman Leddy Memorial Garden Extension NE 16 × 101.

Eucalyptus coccifera Mount Wellington peppermint. Tasmania 1840. Gants Hill, 126 Woodford Avenue 6 × 88; Hampton Court twentieth Century Garden.

Eucalyptus cordata silver gum. Tasmania 1850. Ruskin Park old bowling green 17 × 129. Very few.

Eucalyptus globulus. Dulwich Park no. 9 on Tree Trail.

Eucalyptus leucoxylon 'Rosea'. Chelsea Physic Garden formal lawn 4 × 33. Scarcely tried.

Eucalyptus mitchelliana Mount Buffalo Sally. Australia. Syon Park N or E end of lake, in Eucalyptus group 11 × 86. Very rare.

Eucalyptus nitens silver top. New South Wales. Pitshanger Park Ealing, edge by Brentcot Close, fine young tree 11 × 73; Syon Park N of Flora 23 × 170 and 24 × 167 (hybrids?).

Eucalyptus viminalis. Before 1885. Inwood Park Hounslow NW corner 18 × 167; Hayes Middlesex (S of Cottage Hospital) Norman Leddy Memorial Garden, path to Extension, 18 × 190.

Eucommia ulmoides gutta-percha tree. China about 1896. Cannizaro Park, young tree by entrance; Hampton Court, good tree 10 × 114 in The Wilderness and another *c.* 11 × 111 S of Privy Garden; Maryon Park Charlton, fine tree 8 × 88 near tennis courts, N end near Woolwich Road; Myddelton House 8 × 48.

Fagus orientalis oriental beech. E Europe, Asia Minor 1904. Crystal Palace Park, vigorous young tree in carpark by Sydenham entrance 13 × 114 in 1998.

Fagus sylvatica 'Cristata' cock's comb beech. C 1811. Avenue House Finchley 13 × 167; Greenwich Park Flower Gardens N Lawn 10 × 111.

Fagus sylvatica 'Purpurea Tricolor'. C 1888. Avenue House Finchley; Osterley Park Great Meadow NW, 22 × 231; Syon Park compartment 2.40 24 × 249 Champion.

Fagus sylvatica 'Rotundifolia'. C 1872. Hall Place, Bexley Main Garden 12 × 137; City of Westminster Cemetery Hanwell by E wall no. 561 9 × 104; Kensington Gardens E of Round Pond.

Fraxinus americana white ash. E N America 1724. Alexandra Park Palace Way just N of Palace 12 × 66; Barham Park Sudbury playground at W end, good tree 17 × 157; Burgess Park Walworth NW of lake 12 × 86; Clayhall Park Gants Hill E corner S 12 × 111; Gunnersbury Park N end carpark, good slender tree 17 × 177; Ickenham Derwent Avenue street planting outside 46 12 × 139; Kensington Gardens S of bandstand (Bean 1973, 1988); Valentines Park Rose Garden 11 × 71; Victoria Park Hackney near Crown Gates W grafted at 2m 169cm girth (Bean 1973, 1988), young tree near Molesworth Gate 108cm girth.

Fraxinus angustifolia ssp. *oxycarpa.* SE Europe to SW Asia 1815. Brockwell Park Water Lane gate E fence 19 × 231; Clissold Park by bowling green 21 × 302 Champion; Gunnersbury Park, in group N of carpark 21 × 238 and 19 × 195; Myddelton House 24 × 181 Champion. Rare 'wild' form - now increasingly planted as 'Raywood'.

Fraxinus angustifolia 'Pendula'. Battersea Park N edge of Meadow area 10 × 114; Horniman Gardens, Forest Hill NE gate 15 × 312 (labelled 'excelsior') Champion. Very few known.

Fraxinus angustifolia 'Veltheimii'. Kensington Gardens N of Round Pond, three trees 21 × 340 Champion, 22 × 236, 20 × 274 (Bean 1973, 1988); Regent's Park Primrose Hill (Bean 1973, 1988), two trees remain 2002; Queen's Park 17 × 256; Little Wormwood Scrubs Recreation Ground, 15 × 274 at 1.8m. Most of the surviving British specimens.

Fraxinus latifolia Oregon ash. N America C 1870. Regent's Park Outer Circle opposite Hanover Terrace, 25m W of entrance gate, 18 × 271 Champion; Avenue House Finchley NW 8 × 58.

Fraxinus pennsylvanica red ash. E N America 1783. Ickenham Derwent Avenue street planting outside 23 8 × 88, very downy; Kensington Gardens S of bandstand largest of 3 190cm at 1.5m; Marble Hill Park mid NE13 × 190; Mill Hill Park 8 × 86, very downy; Preston Park Harrow W side 14 × 185, good tree; Ruskin Park grafted at 1.8m; Syon Park; Valentines Park NE edge 12 × 86; Woodcock Park Kenton centre 15 × 180.

Fraxinus pennsylvanica 'Variegata'. Kensington Gardens N Walk 18 × 137 Champion.

Fraxinus velutina Arizona ash. SW USA, N Mexico 1891. Cannizaro Park E of Maple Avenue W arm Tree List no. 55; Hyde Park S of S Carriage Drive no. 24197 in shrubbery next to Hyde Park Hotel.

Fraxinus xanthoxyloides Afghan ash. C 1870. Syon Park compartment 2.10 (Bean 1988) 10 × 198 Champion. Very rare.

Ginkgo biloba (female trees). Battersea Park, two near Pagoda; Chelsea Physic Garden E Quarter no. 109; Fulham Palace Park; Greenwich Park Gardens; Kensington Gardens W end of Flower Walk; Seething Lane Pepys Garden, two; Terrace Gardens Richmond. Scarce in London.

Gleditsia sinensis Chinese honey locust. 1774. Chelsea Physic Garden E Quarter no. 96, planted before 1920 12 × 177.

Gleditsia triacanthos 'Nana'. USA 1700. Holland Park Azalea Walk, graft at 1m 14 × 195; Victoria Park Hackney, W edge, forks at 1.5m 19 × 248 at 0.8m. Only these London trees noted. Figure 1.

Grevillea robusta silk oak. W Australia. Rotherhithe, 3 trees in Lower Road outside Police Station 2002, largest 5m. Remarkable - never considered cultivable out-of-doors in Britain. Figure 3.

Gymnocladus dioica Kentucky coffee tree. Before 1748. Brockwell Park NE from mansion 13 × 139 and NW 9 × 124; Battersea Park 2 fine trees N of bandstand 16 × 149 and group of 5 in Festival Gardens; Cannizaro Park Heather Garden Tree List no. 26; Dulwich Park (College Road entrance) *c.* 11 × 111; Dulwich Picture Gallery 13 × 177 at 1m; Finsbury Park, good tree near Manor House Gate 11 × 101; Greenwich Park Flower Gardens, large tree by Heather Beds and 2 by lake; Holland Park Oak Enclosure 14 × 162; Mountsfield Park Lewisham, George Lane gate 13 × 139; Purley Oaks Wettern Tree Garden 16 × 121; Regent's Park NE Rose Gardens 10 × 116 at 1m; Richmond Terrace Gardens, a shoot re-growing from felled tree; Hackney Victoria Park Rose Garden 13 × 151and N of lake 13 × 137.

Juglans cinerea butternut. N America C 1633. Ravenscourt Park a young tree to replace lost veteran. Very rare.

Juglans mandshurica Manchurian walnut. 1859. Syon Park no. 100 compartment 2.30 17 × 195 Champion, Duke's Garden 12 × 114; Danson Park, View Road entrance 8 × 142. Very rare.

Kalopanax septemlobus. E Russia, Far East 1865. Greenwich Park Flower Garden W border 14 × 190 Champion. Rare as the type.

Koelreuteria paniculata 'Fastigiata'. 1888. City of Westminster Cemetery Hanwell E side mid S 11 × 50; Woodford St Anthony's Avenue front garden of 79 13 × 86 at 1m Champion.

+*Laburnocytisus* '*Adamii*'. Paris 1825. City of Westminster Cemetery Hanwell mid E, N tree 8 × 66, S tree 6 × 58.

Liquidambar formosana Chinese sweet gum. 1884. Woodcock Park Kenton N side W 9 × 48.

Liquidambar formosana var. *monticola*. China 1908. City of Westminster Cemetery Hanwell SW no. 207 11 × 63; Holland Park North Lawn W edge 16 × 93; Kensington Gardens North Walk, young.

Liquidambar orientalis. Turkey 1750. Cannizaro Park border by Keir Lawn; Chelsea Physic Garden NE Quarter no. 39 planted 1988; Kensington Gardens N Walk, young; Montpelier Park 4.5 × 96 at 0.6m; Syon Park, small. Very rare.

Lonicera maackii. Manchuria, Korea 1880. Woodcock Park, Kenton N, very broad 6 × 154 at 0.3 m.

Luma apiculata. Chile 1843. Chelsea Physic Garden Swan Walk edge S 5 × 66 at 0.1m. Scarcely grown away from the west coast.

Lyonothamnus floribundus Catalina ironwood. Santa Catalina island, California. Chelsea Physic Garden SW Quarter no. 84 planted by 1983.

Lyonothamnus floribundus ssp. *asplenifolius*. Californian islands 1900. Cannizaro Park on R of main uphill path through Mary Jane Wood; Chelsea street trees in Glebe Place and Wilbraham Place. Figure 7.

Maclura pomifera Osage orange. USA 1818. Purley Oaks Wettern Tree Garden 12 × 145+100 abundant fruit in 2003; Syon Park, small.

Malus halliana China, Japan 1863. Beacontree, Valence House grounds, mid, all branches shed except two 6 × 88.

Malus trilobata. E Mediterranean 1877. Cannizaro Park main lawn (Tree List no. 16); City of Westminster Cemetery Hanwell, mid, fine tree 12 × 127; Holland Park Oak Enclosure, slender tree 11 × 50.

Malus yunnanensis. China 1900. Cannizaro Park Birch Grove/lawn edge 9 × 86; Highgate, Magdala Avenue street tree, mid 6 × 76.

Melia azedarach bead tree. Asia to Australia, C in England since 1500s. Chelsea street trees by 1 St Leonard's Terrace and in Wilbraham Place.

Morus alba 'Pendula' white mulberry. Eltham, Well Hall Pleasaunce W 3 × 50.

Nothofagus dombeyi. Chile, Argentina 1916. Cannizaro Park by path in Mary Jane Wood 17 × 149; Barkingside Cemetery, Garden of Rest 7 × 50.

Nothofagus solandri var. *cliffortioides* mountain beech. New Zealand. Chelsea Physic Garden NW Quarter no. 47.

Nyssa sinensis. China 1902. Eastcote House grounds W 5 × 33; Syon Park, small.

Olea europaea olive. Cannizaro Park in walled garden; Chelsea Physic Garden, old tree; Gladstone Park on slope and in walled garden; Hyde Park Estate W2, young tree in Connaught Square, another in Hyde Park Square; Golders Hill Park; Sunray Gardens SE24 small.

Ostrya carpinifolia hop hornbeam. S Europe, W Asia 1724. Avenue House Finchley NW gate 10 × 101; Capel Manor, Enfield W of S lawn 12 × 86; City of Westminster Cemetery Hanwell SE no. 417 11 × 111; Dulwich E verge of College Road S of Frank Dixon Way, slender old tree 9 × 53; Kelsey Park, Beckenham E edge 11 × 86; Kensington Gardens 3 trees W of Queen's Gate; Kew Green outside garden gate 9 × 99 and 9 × 91; Osterley Park NE meadow near lake 9 × 99; Regent's Park opposite Broad Walk café; Syon Park Duke's Garden 18 × 205.

Ostrya japonica. Far East 1888. Syon Park, young.

Ostrya virginiana. E N America 1692. Montpelier Park.

Paulownia fortunei. China. Chelsea Physic Garden SW Quarter no. 56 8 × 86; Hampton Court Lion Gate border W tree GO255 17 × 208, E tree GO256 17 × 190, Champions; Syon Park.

Paulownia kawakamii. Chelsea Physic Garden SW Quarter no. 70 8 × 73. Very rare.

Paulownia tomentosa 'Lilacina'. China C 1908. Chelsea Physic Garden SE Embankment & Triangle beds no. 122.

Persea americana avocado. C America. Chelsea in front of 3 St Leonard's Terrace 5.5 × 55. Figure 4.

Phellodendron amurense Amur cork tree. NE Asia 1885. Cannizaro Park small lawn S of Sunken Garden; Chelsea Physic Garden SW Quarter no. 56 planted 1991; East Ham Central Park; Hampton Court Wilderness; Myddelton House near conservatory.

Platanus × *hispanica* 'Augustine Henry'. Barnes St Paul's School towpath, E of pair good tree 26 × 436; Chelsea Cheyne Walk Gardens street tree 29 × 381; Highbury Fields SE corner in N field 23 × 365; St James's Park SW1 N of bridge (Bean 1988); St James's Square St James Duke of York Street gate 29 × 284.

Platanus orientalis. SE Europe, early sixteenth century. Mill Hill School, Mansion lawn. 18 × 335. Rare cuneate form.

Populus alba 'Raket'. Greenford, Ravenor Park, in avenue 18 × 142; Yeading, Rectory Park, series S of play area, vigorous young tree 19 × 137. Scarcely seen as yet.

Populus × *berolinensis* Berlin poplar. Cannizaro Park, Mary Jane's Wood 27 × 177; City of Westminster Cemetery Hanwell S edge W 22 × 203; High Elms Country Park E corner of lawn by Shire Lane 29 × 299.

Populus lasiocarpa Chinese necklace poplar. China 1900. Battersea Park near bandstand; Hampton Court in 20th Century Garden 9 × 73.

Populus simonii. China 1913. Acton Park 18 × 205 Champion; Northolt Wood End Lane, 5 trees on grass verge, Mandeville Road end 1996; S. Harrow Preston Park three trees; Woodford Ray Park two trees; several in belt around Mogden Water Treatment Works, Isleworth (Whitton Dene edge).

Populus tremula 'Pendula' weeping aspen. Cannizaro Park S end of Maple Avenue 7 × 73.

Prunus 'Choshu-hizakura'. East Ham Central Park, mid S 8 × 127 Champion.

Prunus × *dawyckensis* Dawyck cherry. Woodford, White House, planted 1996 by M. Arnold Smith 8 × 45. Very rare.

Prunus dulcis 'Roseoplena'. Double almond. Camberwell, Brenchley Gardens 4 × 86.

Prunus jamasakura hill cherry. Japan C 1914. Bushy Park Waterhouse Woodland Gardens, S of stream E 9 × 101; Kelsey Park Beckenham E edge 14 × 101.

Prunus pensylvanica. N America 1773. City of Westminster Cemetery Hanwell, mid NE 8 × 86. The only one known?

Prunus verecunda Korean hill cherry. 1907. Syon Park, Flora's Lawn SE, shapely top-grafted tree labelled 'P. sargentii' 9 × 162 Champion. Very rare.

Ptelea trifoliata hop-tree. East N America, Mexico 1704. Cannizaro Park by Keir lawn; Syon Park, small.

Pterocarya × *rehderana* hybrid wing nut. Golders Hill Park; Hyde Park, by Hyde Park Corner tube station no 25002; Hyde Park SW of Stanhope Place Gate 38081, young; Montpelier Park 16 × 205, 17 × 233 among limbs; St James's Park S 10 × 104; Woodcock Park NE 19 × 299, very fine.

Pterocarya rhoifolia. Japanese wing nut. 1888. Hyde Park near Stanhope Place Gate, no. 38082, planted *c.* 1995; Hyde Park, between Albion Gate and Victoria Gate another young tree no. 14210.

Pterocarya stenoptera Chinese wing nut. 1860. Avery Hill Park, Greenwich, near hedge at top of sports field, a very good tree 13 × 261; Hall Place Bexley *c.* 5m; Hayes Middlesex Norman Leddy Memorial Garden bush 10m; Hyde Park near Stanhope Place Gate, vigorous young tree no. 38036; Montpelier Park girth 220cm; Ravenscourt Park E of pond 18 × 292; Syon compartment 2.50 12 × 137.

Pyrus × *michauxii.* City of Westminster Cemetery Hanwell NE, good tree 9 × 104 Champion; Hall Place Bexley Spring Garden 7 × 76; Holland Park Oak Enclosure 12 × 101 Champion.

Pyrus pyrifolia sand pear. China 1908. Hall Place Bexley Spring Garden 13 × 127 and 8 × 101; Syon Park SE of Conservatory, in shrubbery border, leans 12 × 142; Hampton Court Wilderness 12 × 101.

Quercus acutissima sawtooth oak. Far East 1862. Hyde Park E of New Lodge. 37033, planted 1998.

Quercus aliena Far East, Thailand 1905. Hyde Park, E of New Lodge. 37030, planted 1998.

Quercus bicolor swamp white oak. SE Canada, E USA 1800. Kensington Gardens, W of Fountains 21 × 248; Cannizaro Park, young; White House, Woodford, planted by Mr B. Mintener 1996 7 × 35.

Quercus castaneifolia chestnut-leaved oak. Caucasus, Iran 1846. Dulwich, College Road; East Ham Central Park, young; Ham Common, very good tree 21 × 276; Hanger Hill Park, young; Parsloes Park Dagenham 11 × 129; Ravenscourt Park, two; Syon Park compartment 5.10.

Quercus castaneifolia 'Green Spire'. Cannizaro Park tennis court garden, N edge 13 × 76.

Quercus coccifera Kermes oak. Mediterranean, since 17th century. Chelsea Physic Garden, office side 6 × 63.

Quercus dentata Daimyo oak. Far East 1830. Gunnersbury Park, Hampton Court Wilderness, Osterley Park, Syon Park.

Quercus infectoria. Greece, N Turkey 1850. Syon Park compartment 5.10 20 × 297 Champion.

Quercus × *leana* Lea's hybrid. Syon two trees compartments 2.50, 5.10.

Quercus libani Lebanon oak. Asia Minor about 1855. Cannon Street, opp. St Paul's Cathedral, fine young pavement tree; East Ham Central Park, young; Golders Green Crematorium; Hampstead Heath (Tanza Road border); Harrow Road, opp. 342; Harrow Road opp. entrance to Westbourne Green, fine young tree; Holland Park Oak Enclosure 14 × 142; Hyde Park no. 21088 between Lido and Dell 11 × 101; Richmond Terrace Gardens NE edge; Syon Park Rose Garden/Church Walk 17 × 149. Figure 8.

Quercus macranthera. Caucasus 1873. Brockwell Park, two trees by Clock Tower near mansion 14 × 241 and 13 × 221; Cannizaro Park, Maple Avenue S end 10 × 48; Golders Green Crematorium hilltop rose garden 15 × 182; Hampstead Heath near Tanza Road; Harrow Road, two trees opposite Amberley Road; Springfield Park Hackney.

Quercus macrocarpa bur oak. N America 1811. Holland Park Oak Enclosure 25 × 266 Champion (Bean 1988) – Mitchell considered this to be emphatically the best specimen of bur oak on this side of the Atlantic (FHP 1982); Syon Park compartment 2.30 24 × 271 Champion.

Quercus marilandica black-jack oak. E USA C 1739. Osterley Park, old tree. Very rare.

Quercus muehlenbergii Chinkapin oak. N America, N Mexico 1922. Syon Park N of lake, E of bridge, recumbent 10m. Very rare.

Quercus myrsinifolia bamboo-leaved oak. China, Japan 1854. Syon Park compartment 2.20 13 × 139 Champion (Bean 1988).

Quercus nigra water oak. SE USA 1723. City of Westminster Cemetery Hanwell no. 150 13 × 170; Syon Park NW of lake bridge, vigorous domed tree 14 × 167. Very rare.

Quercus petraea 'Columna'. Syon Park N of E end of lake 10 × 63. Very rare.

Quercus petraea 'Mespilifolia' medlar-leafed oak. Holland Park Oak Enclosure 22 × 274; Osterley Park in woods 24 × 195; Syon Park Church Walk, re-growing after 1987 damage 19 × 299.

Quercus phillyreoides. Far East 1861. Castle Lane Victoria SW1.

Quercus pubescens downy oak. Europe, Turkey. Avenue House Finchley 18 × 287; Regent's Park Inner Circle at base of mound by lake, near waterfall, girth 230cm.

Quercus pyrenaica Pyrenean oak. SW Europe, N Italy 1822. Cannizaro Park Rose Garden; Fulham Palace Park (Bean 1988, refound 2001 by Di Kennedy); Holland Park 'Pendula' 9 × 96 (Bean 1988); Syon Park Church Walk 18 × 236 (Bean 1988). Very rare.

Quercus robur 'Filicifolia'. Avenue House Finchley by pond 6 × 63. Richmond Park Pembroke Lodge, young tree near Henry VIII's Mound.

Quercus × *schochiana*. C 1894. Richmond Park Isabella Plantation and at Petersham Lodge by Henry VIII's mound, 12 × 121.

Quercus × *turneri* 'Spencer Turner'. Essex, eighteenth century. Fulham Palace Park in allotment area 11.5 × 231; Hyde Park opposite bandstand 17 × 193; Primrose Hill by St Edmund's Terrace gate 12 × 180. Very rare.

Rhus chinensis. Far East, Malaysia 1737. Chelsea Physic Garden Philip Miller garden 4 × 66. Very rare.

Rhus potaninii. China 1902. Hyde Park, S boundary of Nursery.

Rhus punjabensis [?]. Chelsea Physic Garden Swan Walk edge 8 × 114.

Robinia pseudoacacia'Tortuosa'. Brockwell Park, Dulwich Road edge S 10 × 76 at 1m; City of Westminster Cemetery nos. 172, 564 mid E side 6 × 19.

Robinia pseudoacacia 'Unifoliola'. Hyde Park SW of Nursery entrance two trees 21 × 205, 17 × 215; Mill Hill Ashley Walk by 20 15 × 101; Mill Hill Milespit Hill by 36 12 × 88; Ruskin Park S of bowling green 12 × 96; street trees in Ladbroke Grove area to 15 × 127.

Sassafras albidum. East N America 1633. Cannizaro Park 18 × 157, very fine, Champion; Syon Park, young.

Sophora japonica 'Pendula'. Battersea Park by fence at W end of 'Meadow'; Gunnersbury Park in Japanese Garden 4 × 66; Dulwich Park in shrubby border; Holland Park, small; Kennington park in shrubby border.

Sophora tetraptera kowhai. New Zealand 1772. Avery Hill Park Rose Garden 8 × 73; Battersea Park, Old English Garden; Brockwell Park walled garden; Golders Hill Park; Kensington Gardens N Walk; Deptford Sayes Court Park 1997; Lesnes Abbey by toilet block 8 × 66; Sutton, St Nicholas Way bush by shopping centre. Very few in SE.

Sorbus alnifolia. Far East 1892. Cannizaro Park Maple Avenue. 13 × 127.

Sorbus americana American mountain ash. East N America 1782. Kensington Gardens SE of bandstand, group of three 11 × 119 Champion, 9 × 116, 9 × 111.

Sorbus aucuparia 'Asplenifolia'. Holland Park Oak Enclosure, crowded and reverting 14 × 66; Mayow Park Sydenham W side 10 × 129; Osterley Park N border of Pinetum 14 × 121.

Sorbus aucuparia 'Dirkenii'. Chiswick St Peter's Church of England Primary School, young vigorous tree 7 × 40; Yeading Newdene Avenue, street tree by 57, old domed plant 4.5 × 61.

Sorbus domestica service tree. S and E Europe. Cannizaro Park in Mary Jane Wood; Crystal Palace Park farmyard three trees to 20 × 254; Fulham Palace Park in walled area; Hanwell Community Centre, Cuckoo Avenue, Ealing 17 × 238; Haringey St Ann's Hospital 12 × 99; Holland Park; Maryon Park 15 × 180; Richmond Terrace gardens; Roe Green Park, pyriformis 13 × 205. Also in Beckenham Cator Park, Clapton Square gardens, Ilford South Park, Putney Vale Memorial Gardens, and Wanstead High Street Recreation Ground.

Sorbus folgneri. China 1901. Capel Manor Enfield, Bacchus Temple 8 × 61. Confined to the biggest gardens.

Stewartia sinensis. China 1901. Kensington Gardens E end of Flower Walk; Syon Park compartment 5.10.

Styrax obassia. Japan 1879. Coram's Fields, W edge by Lansdowne Terrace behind railings, planted by Chris Nicholson, former Administrator.

Tetradium daniellii. China, Korea 1905. Avenue House Finchley; Cannizaro, S side of Keir Lawn 8 × 111 and S end of Sorbus Avenue; City of Westminster Cemetery Hanwell no. 472; Hampton Court Wilderness 10 × 162; Greenwich Park rockery by toilets 14 × 142; Hyde Park, two trees at rear of Bowater House; Kensington Gardens near Orangery; Normand Park Fulham, Lillie Road entrance; Regent's Park 12 × 152 at 1m; St James's Park 18 × 215; Syon Park, in border by model railway 14 × 152.

Tilia americana American lime. N America 1752. Hyde Park Lovers Walk × 4 including 12-200, 201, 202; King Square Finsbury 3 in front of flats 16 × 190; Marble Hill Park NE, playground, graft at 1.3m 16 × 139; Peckham Rye Park Arboretum W, grafted at 2m 17 × 137; Telegraph Hill Park New Cross SW gate 15 × 127; Woodcock Park Kenton N side 15 × 127.

Tilia 'Moltkei'. South Park, Ilford E edge two trees 17 × 274 Champion, and 17 × 203.

Tilia mongolica Mongolian lime. 1880. Avenue House Finchley; Cannizaro Park Tennis Court garden E edge 12 × 127; City of London Cemetery Hanwell no. 447 11 × 114; Mill Hill Park 5 × 48 1995; Priory Park, Hornsey three young trees, largest 8 × 58; York House Twickenham 8 × 58.

Toona sinensis. China 1862. Chelsea Physic Garden SW Quarter no. 81 planted 1986; Hyde Park feature in Rose Garden; Syon Park compartment 2.30 N of lake 13 × 124.

Trochodendron aralioides. Far East C 1894. Richmond Park Isabella Plantation above Peg's Pond, broad and bushy 8 × 154.

Ulmus × *hollandica* 'Wentworthii'. City of Westminster Cemetery Hanwell entrance 3 × 60.

Ulmus japonica. Japan. Kensington Gardens near Lancaster Gate 10 × 96; Ranelagh Gardens Chelsea 4 × 71; Regent's Park top of Broad Walk 6 × 73. Scarcely grown until recently.

Ulmus laevis European white elm. C Europe to W Asia. Ladywell Fields Lewisham by middle fields; Tooting Bec Common NE corner by railway underpass 20 × 269. Very rare.

Ulmus parvifolia. Far East 1794. Hyde Park by Rotten Row opposite Dell Bridge, nos. 10-223, 237, 245, 246, 248; Syon Park Church Walk 4 × 22.

Ulmus 'Pinnatoramosa'. C 1894. Barnsbury, Barnsbury Street opposite S&S Stores 17 × 205; Battersea Park NE corner opposite entrance to 'Meadow' 15 × 182; Hyde Park N of New Lodge no. 37258 16 × 167; Westbourne Green several; Woodcock Park Kenton 14 × 127.

Umbellularia californica Californian laurel. 1829. Chelsea Physic Garden 12 × 111; Golders Hill Park; Greenwich Park Flower Gardens 11 × 180; Gunnersbury Park in old Japanese Garden 15 × 238; Holland Park Kyoto Garden 17 × 259, by Tennis Courts 8 × 104; Kensington Gardens Flower Walk 17 × 167; Normand Park Lillie Road 10m; Sydenham Wells Park 11 × 101; Morden Ravensbury Park by paddling pool 16 × 243.

Vitex agnus-castus chaste tree. Mediterranean to Central Asia C 1570. Chelsea Physic Garden E Quarter no. 92, planted by 1977; City of Westminster Cemetery Hanwell no. 96 NW of Chapel, twin-stemmed old tree which still flowers profusely.

Xanthoceras sorbifolium. China 1866. York House Gardens Twickenham, small old tree by tennis courts.

Zanthoxylum ailanthoides. Chelsea Physic Garden by E path 3m.

Zanthoxylum americanum toothache tree. N America C 1740. Chelsea Physic Garden NE Quarter no. 27.

Zelkova sinica. China 1908. Wormwood Scrubs by Park Lodge Old Oak Common Lane, fine tree 13 × 182. Figure 5.

Ziziphus jujuba jujube. SE Europe to China. D'Oyley Street, Chelsea.

Lichens in the 'Magnificent Seven' cemeteries — a baseline survey of seven cemeteries in London

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Abstract

Lichens have been included in the GLA Habitat Action Plan for Churchyards and Cemeteries and this paper provides a baseline survey of lichens in the 'Magnificent Seven' cemeteries. These were built in a ring around London in the mid nineteenth century. It is hoped that this will stimulate monitoring and recording in them.

Introduction

In the mid seventeenth century the Nonconformists created a burial ground in Bunhill Fields — until this time burials in London were usually in churches and churchyards. In 1657 a Jewish burial ground was created in the East End and different burial practices were accepted. No longer was the church and churchyard the only accepted place of burial. It was considered unhygienic to have burials in churches in the City and by the eighteenth century Sir Christopher Wren, John Evelyn and Sir John Vanbrugh favoured the neoclassical idea of a park-like burial ground. In 1714 the first such burial ground was opened in Bloomsbury, the forerunner of the magnificent cemeteries to come.

The real change came with industrialization and the mass movement of people to the cities. Joint Stock companies ran cemeteries for profit — the first being All Souls Cemetery, Kensal Green opened in 1833. In 1843 John Claudius Loudon published 'On the laying out of cemeteries', and in 1850 the Metropolitan Interment Act saw the closing of urban churchyards for burial and allowed publicly funded cemeteries in London. The Magnificent Seven are from this mid nineteenth century era and ring London with memorial parks of splendid plantings and magnificent monuments, each of which has had a slightly different history. Burial practices continued to change with the Cremation Society being founded in 1874, the first cremation taking place in Brookwood, Woking, in 1885, and the large crematorium at Golders Green opening in 1902. Following World War I, and the War Graves Commission's example, simple memorials became popular.

Today it is acknowledged that there is an acute shortage of burial space and the old cemeteries are being looked at again. Cemeteries and crematoria do not have a long ecological history, having started in the industrial age, but they are important open spaces in an urban context. Lichens like the continuity of habitat that churchyards and cemeteries provide in cities but they are also open to threats from man and nature. In London the main threat has been air pollution which turned London into a lichen desert (Laundon 1970, Rose and

Hawksworth 1981). Legislation meant that air quality improved but vandalism and overgrowth, especially with ivy, sycamore and brambles, are other threats. Having been neglected these cemeteries are now returning to a more vigorous management.

This paper concentrates on the magnificent cemeteries of the Victoria era — Abney Park, Brompton, Highgate, Kensal Green, Norwood, Nunhead and Tower Hamlets — known as the Magnificent Seven (Weinreb and Hibbert 1993, Meller 1994). Some became white elephants and were abandoned, to be taken over by Friends, such as Highgate and Nunhead, and are now sites of Metropolitan Importance for Nature Conservation. Abney Park and Tower Hamlets are also run as Nature Reserves.

The cemeteries

Abney Park Cemetery

Originally the town house of Sir Thomas Abney (a leading nonconformist and Lord Mayor of London 1700–1), the thirty-acre site was owned by the Abney Park Cemetery Company. It opened in 1840 as unconsecrated ground and 30 per cent of all burials were of Dissenters, making it heir to Bunhill Fields. William Hosking designed the Egyptian entrance lodges, which now house the offices, and the Gothic chapel. Loudon (1843) commented that it was one of the most complete arboretums in the neighbourhood of London, all the trees and shrubs being named. In 1978 the cemetery, in a vandalized overgrown state, was bought for £1 by the London Borough of Hackney. It is a Site of Metropolitan Importance for Nature Conservation.

Brompton Cemetery

The West of London and Westminster Cemetery Company bought forty acres of land from Lord Kensington in 1837 and the cemetery was consecrated in 1840. Benjamin Baud won a competition for the design of walls, chapels, catacombs and buildings but the company ran into financial difficulties and the complete design was not carried out. In 1852 the cemetery was bought by the General Board of Health and was thus the first London cemetery under state control. It was however soon filled and is now maintained by the Royal Parks, in conjunction with Kensington Gardens. It is a Site of Borough Importance for Nature Conservation.

Highgate Cemetery

The Cemetery of St James at Highgate was opened by the London Cemetery Company, whose founder, Stephen Geary, designed and planned the seventeen and a half-acre site. The site, beneath Highgate's St Michael's Church, covered part of the grounds of Sir William Ashurst's (Mayor of London 1693) mansion and thus there were mature plantings. Geary created a Gothic design on a classical plan with the help of David Ramsay, landscape gardener. Also incorporated was an arch of Egyptian columns and obelisks beyond which is the Egyptian Avenue which leads under a bridge to the Circle of Lebanon, a site for catacombs that surrounds a cedar of Lebanon from the original grounds. The Bishop of London consecrated it in May 1839. In 1857 an extension the other, eastern, side of Swain's Lane was added making a total of thirty-seven acres. Many famous people are buried there including Michael Faraday and Christina Rossetti and, on the eastern side, George Eliot and Karl Marx. In the 1960s the United Cemetery Company, the successor of the London Cemetery Company, let the site fall into disrepair and in 1975 the Friends of Highgate Cemetery was formed and acquired the freehold in 1981, transferring it to the Custodian of Charities in 1989. It is a Site of Metropolitan Importance for Nature Conservation.

Kensal Green Cemetery

All Souls Cemetery was the first of the large commercial cemeteries to be opened in London. The General Cemetery Company was founded in 1830, and in 1831 fifty-four acres of land south of Harrow Road were bought for £9,400; 800 trees planted and a competition won, in 1832, by H.E. Kendall for a Gothic design. However, the wishes of the Chairman, Sir John Dean Paul, for a Greek Revival plan prevailed, possibly the work of the company's surveyor, John W. Griffith. The cemetery is entered by a large Doric arch incorporating offices and a residence, from which three gravelled roads wide enough for carriages diverge to north and south, with the central one going to the Anglican Chapel underneath which are extensive catacombs. At the eastern end is an Ionic nonconformist chapel, and along the north wall are further catacombs. In January 1833, thirty-nine acres were consecrated by the Bishop of London, the remaining fifteen acres, to the east, being reserved for Dissenters. The burial of the Duke of Sussex, sixth son of King George II, in 1843, and his sister, Princess Sophia, six years later, gave the cemetery the seal of social approval. This is the chosen burial place of J.C. Loudon, the cemetery author, as well as many other writers and actors and the Brunels, engineers. The Cemetery is still open and managed by the same company. It is a Site of Metropolitan Importance for Nature Conservation.

Nunhead Cemetery

The Cemetery of All Saints was the second, after Highgate, to be planned by the London Cemetery Company. The thirty-acre site, laid out by J.B. Bunning, was opened for burials in 1840. There is a wooded hillside with many large old family vaults as well as a memorial to the five 'Scottish martyres' who campaigned for Parliamentary Reform and were transported in 1793. The inscription reads 'The experience of all ages should have taught our rulers that persecution can never efface principles.' The cemetery fell into disrepair and was vandalized — as a result the Anglican chapel is a roofless shell, the Dissenters' chapel has been demolished and many graves destroyed. It was eventually closed in 1969. A special Act of Parliament in 1975 enabled the Borough of Southwark to take it over. Since April 1980 the cemetery has again been open for burials. It is a Site of Metropolitan Importance for Nature Conservation.

Tower Hamlets Cemetery

The most easterly cemetery in this group was opened in 1841 by The City of London and Tower Hamlets Cemetery Company and consecrated by the Bishop of London. However it soon became overgrown and the graves were so crowded that it was said to have 'a curious air of Cockney togetherness even in death'. The Cemetery's chapel and lodges were damaged in World War II and later demolished. Since 1966 the Greater London Council has maintained it. It is a Site of Metropolitan Importance for Nature Conservation.

West Norwood Cemetery

The South Metropolitan Cemetery Company bought forty acres of land in 1837 and Sir William Tite designed a cemetery with two Perpendicular Gothic chapels set at the top of sloping lawns, among magnificent trees. The Bishop of Winchester consecrated it and five years later land in the north-east corner was acquired for a Greek cemetery. The Anglican and Dissenters' chapels were damaged in World War II and demolished. In 1966, when the Borough of Lambeth bought it, the cemetery was full and overgrown. Their intention was to turn some of it into a nature park with the tombstones left intact. Many famous people are buried here including Mrs Beeton, the cookery writer, Dr William Marsden, the founder of two hospitals, and Sir Henry Tate, who gave the Tate Gallery to the nation. It is a Site of Borough Importance for Nature Conservation.

Pollution history and threats

The main threat to London lichens has beem air pollution, particularly sulphur dioxide (Laundon 1970). The types of air pollution are changing (van Herk 1998, James et al. 2002) and the reinvasion of lichens follows a different strategy from their loss (Hawksworth and McManus 1989).

The type of stone will affect the community as calcareous stone acts as a buffer where the pollutant is sulphur dioxide. It would appear that currently the most diverse communities are on calcareous substrates but there is no clear-cut effect. The whole of the top of one flat-topped tomb in Kensal Green was covered in tiny thalli of *Xanthoparmelia mougeotii*, an acid-loving species, but it was not observed elsewhere. Biological and physical processes such as pH changes, chelating of minerals and swelling of organic matter causing physical damage, as well as leaching, oxidation, and temperature changes will affect the substrate.

Illumination and moisture will also affect the community. The bases of old gravestones are often nutrient rich, probably due to the capillary movement of soil water to the surface where salts accumulate (Gilbert 2000). Ivy has been one of the main threats to lichen communities after air pollution. It cuts out the light and may also produce leachates. This might explain why there were few foliose lichens in Highgate Cemetery whereas the trees in nearby Waterlow Park had several parmelioid species including *Flavoparmelia caperata,* and the planes in Swains Lane have a rich community of *Physcias* and even *Hypogymnia physodes*. The ivy clearance, which is taking place in all the cemeteries, is still too recent.

Communities and colonization

Pioneer communities are not so well known as some of the later communities (James et al. 1977; Hill 1994). The calcareous stone appears to be richest at present and the *Aspicilion calcareae* alliance dominates. There is also in places the *Physcietum caesiae* association on tops enriched with bird droppings. The *Caloplacetum heppianae* association appears on the sides of some graves. On acidic stone the *Leprarion chlorinae* with *Psilolechia lucida* is predominant.

There are two factors that are important in the colonization of lichens — the ability to establish and the ability to grow. Laundon (1970) noted that *Caloplaca flavescens*, unlike *Lecanora dispersa*, occurred only on older gravestones and concluded that because of the increase in levels of air pollution it was not possible to colonize new surfaces but once established it was relatively tolerant.

A glance across the table of species shows that the early calcareous colonizers are present — *Lecanora campestris, Verrucaria nigrescens, Caloplaca citrina, Lecanora dispersa,* and occasionally *Caloplaca flavescens.* There are few of the late calcareous colonisers such as *Diploicia canescens, Rinodina gennarii, Xanthoria calcicola, Caloplaca teicholyta, Aspicilia contorta* and *Toninia aromatica.* The acidic colonizers are not so common, *Candelariella vitellina* and *Porpidia tuberculosa* are there but *Tephromela atra* is not and has not yet appeared in the Natural History Museum's Wildlife Garden which is closely monitored (Honey et al. 1998). *Lecanora muralis* is however common and is very much an urban lichen (Seaward 1976).

Earland-Bennett (1991) noted the unexpected richness of a London cemetery. A cemetery is full of different niches — saxicolous and corticolous — and it is to be hoped that many more species will be recorded such as those corticolous species being found in central parks (James et al. 2002). Besides the saxicolous niches of the monuments and the corticolous ones of the trees there is also the lignicolous ones of the benches. Other London cemeteries have been recorded (Waterfield 2002) but not all have been published. The top list is sixty-one species and currently a species list of sixty would appear to be low compared with country churchyards where a hundred is thought to mark an exceptional churchyard (Chester 1991, 2001). However these lists are gradually being extended and with that raising awareness of the biodiversity of our city.

Acknowledgements

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The species and nomenclature

Most of the records are field identifications but critical specimens were taken back for microscopic examination. The species concepts are being revised at the moment as a new lichen flora is being worked on. For example, in *Rhizocarpon* it has been found that what we have been calling *R. obscuratum* is in fact usually *R. reductum*, and *R. concentricum* is *R. petraeum*. The latter is usually found growing on more basic substrates. The *Parmelias* have been distributed among the segregated genera that were indicated in the 1992 flora except that *Rimelia* has not yet been accepted and it goes to *Parmotrema*. *Buellia punctata* has become *Amandinea*. The *Lecanora dispersa* group (Froberg 1997) has been looked at and *Lecanora flotowiana* accepted. The species list follows the latest checklist (Coppins 2002), therefore not all descriptions will be found in the flora.

Lichen species in the Magnificent Seven cemeteries

Species	Abney Park	Brompton	Highgate	Kensal Green	Norwood	Nunhead	Tower Hamlets
Amandinea punctata	×	×	×	×	×	×	×
Aspicilia contorta				×			
Bacidia arnoldiana		×		×			
Belonia nidarosiensis					×		
Buellia aethalea	×	×		×			
Buellia griseovirens	×				×		
Caloplaca citrina	×	×	×	×	×	×	×
Caloplaca crenulatella	×		×			×	
Caloplaca decipiens		×	×	×	×		
Caloplaca flavescens		×		×	×		
Caloplaca flavoctrina		×	×	×		×	
Calolaca holocarpa		×	×		×	×	
Caloplaca teicholyta		×	×	×	×		
Candelariella aurella	×	×	×	×	×	×	×
Candelariella medians		×	×	×	×		
Candelariella reflexa		×					
Candelariella vitellina	×	×	×	×	×	×	
Catillaria chalybeia	×	×			×		
Catillaria lenticularis		×		×	×		
Cladonia chlorophaea	×			×	×		
Cladonia coniocraea		×			×		
Cladonia digitata					×		
Cladonia fimbriata		×	×	×	×		
Cladonia humilis		×		×			
Caldonia pyxidata		×					
Cliostomum griffithii			×				
Collema auriforme				×			
Collema tenax var. *ceranoides*					×		
Cyrtidula hippocastani			×	×			
Cyrtidula quercus			×				
Dimerella pineti	×						
Diplotomma alboatrum			×		×		
Evernia prunastri					×		
Flavoparmelia caperata		×			×	×	×
Flavoparmelia soredians					×		
Hypogymnia physodes					×		
Lecania cyrtella				×			
Lecania erysibe	×	×*	×*	×*		×	
Lecanora albescens	×	×	×	×	×	×	×
Lecanora campestris	×		×	×		×	
Lecanora chlarotera		×	×	×			
Lecanora compallens						×	
Lecanora confusa					×		
Lecanora conizaeoides	×	×	×	×	×	×	×
Lecanora crenulata					×		
Lecanora dispersa agg.	×		×	×	×	×	×
Lecanora expallens		×			×	×	
Lecanora flotowiana		×					
Lecanora hagenii				×			
Lecanora muralis	×	×	×	×	×	×	×
Lecanora polytropa	×	×	×	×	×		
Lecanora stenotropa				×			
Lecanora symmicta	×		×	×			
Lecidea fuscoatra		×		×	×		
Lecidella elaeochroma		×		×			

Species	Abney Park	Brompton	Highgate	Kensal Green	Norwood	Nunhead	Tower Hamlets
Lecidella scabra		×		×			
Lecidella stigmatea	×	×	×	×		×	
Lepraria incana	×	×	×	×	×	×	×
Lepraria lobificans			×	×			
Leproloma vouauxii			×	×			
Melanelia fuliginosa glabratula					×		
Melanelia subaurifera	×						×
Micarea denigrata			×	×	×		
Myxobilimbia sabuletorum			×	×	×		
Parmelia sulcata	×	×	×	×	×	×	×
Parmotrema reticulata					×		
Peltigera didactyla					×		
Peltigera lactucifolia					×		
Peltigera neckeri		×					
Phaeophyscia nigricans		×		×			
Phaeophyscia orbicularis	×	×	×	×	×	×	×
Physcia adscendens	×	×	×	×	×	×	×
Physcia caesia	×	×	×	×	×		
Physcia tenella	×	×	×	×	×	×	×
Placynthiella icmalea		×			×		
Porpidia crustulata	×						
Porpidia soredizodes		×		×			
Porpidia tuberculosa		×	×	×		×	
Protoblastenia rupestris		×	×	×	×	×	
Psilolechia lucida	×	×	×	×		×	×
Ramalina farinacea	×						×
Rhizocarpon petraeum	×						
Rhizocarpon reductum	×			×	×		×
Rinodina gennarii	×	×	×		×		
Sarcogyne regularis		×					
Sarcopyrenia gibba			×	×			
Scoliciosporum chlorococcum		×	×		×		
Scoliciosporum umbrinum		×	×	×	×		
Thelidium incavatum				×			
Thelocarpon epibolium		×					
Trapelia coarctata	×		×	×		×	
Trapeliopsis flexuosa			×				
Verrucaria baldensis			×				
Verrucaria elaeina	×						
Verrucaria glaucina			×		×		
Verrucaria hochstetteri	×	×	×	×	×		
Verrucaria macrostoma		×	×	×	×		
Verrucaria muralis		×		×	×		
Verrucaria nigrescens	×	×	×	×	×	×	×
Verrucaria viridula		×	×	×	×		
Xanthoparmelia mougeotii		×		×	×		
Xanthoria calcicola					×		
Xanthoria candelaria		×			×		×
Xanthoria parietina	×	×	×	×	×	×	×
Xanthoria polycarpa		×	×		×	×	
Species totals	**37**	**59**	**52**	**61**	**60**	**29**	**20**

* sorediate form

Book review

Living with urban wildlife. John Bryant, foreword by Pippa Greenwood, illustrations by Barry Small. 2002. Open Gate Press. 132 pp., paperback. £9.95. ISBN 0 900001 49 6.

Much harm is done to urban wildlife by over zealous reaction to the problems that wildlife can cause in our tamed domestic environments. This book attempts to provide pain-free, non-destructive solutions to what are perceived as wildlife nuisances.

The author, who has spent over thirty years working in the field of animal protection, including senior positions in the RSPCA, the Council of Animal Aid and the League against Cruel Sports, tackles the subject in three main sections: Mammals, Birds and The Future. These are punctuated by simple sketches with a simple, rustic, charm by Barry Small.

The first section deals with foxes, squirrels, moles, rabbits, rats and mice, badgers, deer and bats in separate chapters. The chapter on bats is the shortest, telling us, correctly, to leave them alone. For each of the rest there is a concise account of the life cycle and population trends followed by a discussion of humane ways to protect our urban and home environment. Methods range from conventional (ring-fencing your garden with chemical repellent) to the bizarre (pushing a child's windmill into a mole's tunnel).

Under the Birds heading the author considers herons and garden ponds, but mainly concentrates on flocking birds, pigeons, crows, gulls and geese. For each there is an interesting discussion of municipal attempts at control and frequent failure to do so. The overriding theme here, as in the mammal section, is that numbers are largely controlled by food supply.

The Future restates the purpose of the book, to save lives and prevent suffering, suggests the use of pest control companies only as a last resort, and reflects on how our concern for wildlife is often directly proportional to rarity value.

The book concludes with lists of humane repellent and deterrent suppliers, and useful addresses.

Gardeners, drawn to this book by the foreword by Pippa Greenwood, may be disappointed. Apart from a brief mention of slugs, invertebrates are not covered. This is a serious omission. They are vital in the urban ecology yet some are major garden pests.

Nevertheless, the book is an interesting read and, for the non-specialist, contains much to inform and, occasionally, to amuse on a very important subject.

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Ferns of the metropolis — a status report

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Abstract

A large number and variety of ferns have been recorded in central London, where they were previously absent or rare. In an earlier paper (Edgington 2000) this assertion was quantified and a tentative explanation in terms of changes in atmospheric pollution was offered. However the data presented were restricted to records of just two families of mural ferns in a relatively small area of central London, and the evidence for the explanation proposed was circumstantial.

This paper addresses these issues. It lists observations since 1997, mostly by the author, of ferns within the whole of the Metropolitan district of Middlesex. Comparisons with historical records confirm there has been an overall increase that is not confined to wall ferns but extends to woodland species and affects alien as well as native taxa. The effect of sulphur dioxide on germination and growth is discussed and it is argued that the decline in mural ferns in the nineteenth century, and their recovery in the late twentieth, is mainly due to changes in atmospheric pollution. The increase in woodland ferns may be due to a combination of habitat modification and the existence of substantial spore banks, while climate change as well as fashions in house plants have influenced the appearance and occasional establishment of non-native taxa. Implications for biodiversity are noted.

Introduction

In their *Flora of Middlesex* Trimen and Dyer (1869) wrote: 'About one-sixth of the county is occupied by the metropolis. From a botanical point of view, this is equivalent to an absolute diminution of area to that extent.' This implicit concentration on rural habitats was probably an over-simplification even at the time (but we show below that there were good reasons for their dismissal of the built-up area). A century later, Kent (1960–7) recorded over 550 species of vascular plants growing within a circle of $2^1/_2$-miles radius about Piccadilly Circus, which suggests either a real increase in richness, or better recording, or both. The present paper extends the thesis of an earlier one (Edgington 2000), that six wall ferns previously rare in central London were now at least as common as in the surrounding countryside, to a review of the status of all ferns in the district. Conclusions of the earlier paper were based on observations in an ill-defined recording area (parts of hectads TQ28 and TQ38) so no sensible comparison could be made with historical records, a defect this paper attempts to remedy. Ferns are distinctive, easily recognized, and, in the nineteenth century heyday of 'fern mania', were sought (and collected) in town and country alike. Thus changes in their abundance and distribution should be largely free of recording bias, and have other causes.

A botanical recording unit is almost always artificial. For present purposes it should have a long and well-studied history, include the core urban area of

central London, be large enough to provide statistically significant data, and be capable of mapping on to administrative units for monitoring and management purposes. Units rejected on one or more of these grounds include conventional hectads, the LNHS central London rectangle, and the 2½-miles radius (51 km²) circle that Kent regarded as defining central London. More suitable than any of these is the Metropolitan District of Middlesex, vice-county 21.

Trimen and Dyer divided the vice-county into seven districts on the basis, introduced by Webb and Coleman in their *Flora Hertfordiensis* of 1848, of river drainage, and the same division was adopted by Kent in *The historical flora of Middlesex* (1975). District VII, Metropolitan, is drained by rivers (Fleet, West Bourne, Wall Brook) that even in 1869 were known better as city streets than watercourses. Its boundaries, with minor exceptions, are those of the Middlesex sector of the Metropolitan Board of Works (1855 to 1888) and its successor (to 1965), the London County Council. It includes the City of London, the London Boroughs of Hackney, Islington, Kensington and Chelsea, Tower Hamlets, and Westminster, Camden (except West Hampstead, Fortune Green and North End), the eastern (Fulham) half of Hammersmith and Fulham, the south-eastern portion of Haringey, and a fragment of Brent between Kensal Green and Kilburn. The area of the district is approximately 140 km². It extends over four hectads: TQ27 (22 km², 16 per cent); TQ28 (50 km², 36 per cent); TQ37 (3 km², 2 per cent); and TQ38 (65 km², 46 per cent).

There are advantages besides adequate size and convenient division into administrative units. Botanical recording here has a continuous history of over four hundred years and records are generally well-localized making historical comparisons both meaningful and simple. Moreover, the character of the district has not changed greatly since Trimen and Dyer explored it; by 1869 the built-up area had reached virtually its present extent, while those parts of Hampstead Heath (used here generically to include Ken Wood) within the Metropolitan district have suffered fewer changes than those (West Heath, Sandy Heath and Heath Extension) in adjoining districts.

Records in this paper are assigned to the relevant London boroughs so that any implications for environmental management and biodiversity can be assessed at the local level.

Previous records of metropolitan ferns

On his famous Hampstead ramble of 1629, Thomas Johnson noted only one fern, hard-fern *Blechnum spicant*, to which he later added royal fern *Osmunda regalis* (Gilmour 1972). Two hundred years later Daniel Cooper's *Flora Metropolitana* (1836) added another nine, and Mariano La Gasca's *Hortus Siccus Londinensis* of 1826–7 (Druce 1908) one more, while Alexander Irvine's *The London Flora* (1838) listed five of these twelve. Comparison of these accounts suggests that *O. regalis*, polypody *Polypodium vulgare* (s.l.), bracken *Pteridium aquilinum*, hart's-tongue *Phyllitis scolopendrium*, male-fern *Dryopteris filix-mas* and broad buckler-fern *D. dilatata* were present both on Hampstead Heath and elsewhere, while *B. spicant* was only on the Heath, hard shield-fern *Polystichum aculeatum* grew near Highgate, and rustyback *Ceterach officinarum* was on a wall in Hackney; the rest (maidenhair spleenwort *Asplenium trichomanes*, lemon-scented fern *Oreopteris limbosperma* and lady-fern *Athyrium filix-femina*) were found outside the Metropolitan district, on West Heath or in Highgate Wood. These nine, together with adder's-tongue *Ophioglossum vulgatum* and wall-rue *Asplenium ruta-muraria*, are the Metropolitan ferns listed in 1869 by Trimen and Dyer, who vouched personally for only five, namely adder's-tongue, bracken, wall-rue, male-fern and broad buckler-fern.

From this point, or somewhat earlier given that Trimen and Dyer actually saw fewer than half their list, a decline seems to have set in. Writing about Hampstead a generation later, James Whiting noted male-fern, hart's-tongue, polypody, wall-rue and bracken, and was optimistic: 'It is hardly likely, protected

as the Heath now is, that its flora will be further reduced' (Whiting 1901). A few years later (Whiting 1912) his tone was more despondent; though much of his later essay is a verbatim repeat of that of 1901, making it appear that these ferns, and lady-fern too, were still to be found near the Heath, the only fern G.C.Druce recorded there in the intervening years was *Dryopteris dilatata* at Ken Wood (Druce 1910). These notes by Whiting and Druce are almost all we know of Metropolitan ferns during the last thirty years of the nineteenth century and the first thirty years of the twentieth.

Between 1936 and 1967 three relevant lists appeared in *The London Naturalist*. 'Botanical Records of the London Area' (Bishop et al. 1936: 112–114) lists plants by 'Division'; Division 6 refers to an area some three times larger than the Metropolitan district, which it almost totally surrounds. Only four ferns are listed (bracken, wall-rue, male-fern and broad buckler, that is four of the five seen by Trimen and Dyer) and although the coverage of this series is generally believed to be patchy, it is unlikely that such distinctive species as lady-fern would be missed unless they really were extremely scarce. These four, together with hart's-tongue, adder's-tongue and, for the first time, narrow buckler-fern *Dryopteris carthusiana* from Ken Wood, comprise the seven ferns in 'A hand list of the plants of the London Area' (Kent and Lousley 1957) whose well-localized records are easily referable to the Metropolitan district.

The third list is that in 'A contribution to the flora of central London' (Kent 1960–67), relating to the circular area mentioned above. There are six ferns; adder's-tongue and narrow buckler-fern, both Ken Wood plants, are omitted while lady-fern appears for the first time as a Metropolitan record. Although the area is almost entirely built-up and nearly all records are from walls, the only truly mural ferns found were wall-rue (recorded once) and hart's-tongue (five times). Since these were recorded by such notable experts as Kent himself, R.S.R. Fitter, D. McClintock and R.M. Burton, we can assume that, even if some were missed, mural ferns really were scarce in central London at the time. This is an important conclusion since Kent's series of papers was, together with Fitter and Lousley's (1953) survey of the post-war City of London, one of the first comprehensive reviews of a totally urban flora.

We then come to Kent's *Historical Flora* of 1975 which records eleven taxa in the Metropolitan district. Adder's-tongue and narrow buckler-fern reappear at their woodland sites, together with three species growing as casual wall plants in one or two places: maidenhair fern *Adiantum capillus-veneris* (not native to Middlesex) and the aliens Cretan brake or ribbon fern *Pteris cretica* and house holly-fern *Cyrtomium falcatum*. Ferns not recorded at their known sites since 1869 and which Kent presumed extinct in the district include *Osmunda regalis*, *Polypodium vulgare*, *Ceterach officinarum*, *Polystichum aculeatum* and *Blechnum spicant*, though in the case of the last, Kent with remarkable prescience noted 'it is likely that other plants survive in some of the many enclosures on the East Heath'. The renewed interest in urban recording is illustrated by Hadden's (1978) survey of the W1 postal district where the 157 species she found included bracken, lady-fern, male-fern, broad buckler-fern, hart's-tongue and *Pteris cretica*, all listed by Kent (1975).

Nine new taxa in Kent's posthumous *Supplement to the historical flora* (2000) point to a revival of wall ferns, the additions including a total of eleven records for black spleenwort *Asplenium adiantum-nigrum*, *A.trichomanes*, *Ceterach officinarum* and *Polypodium vulgare*. The other newly recorded taxa are two subspecies of the scaly male-fern *Dryopteris affinis*, water fern *Azolla filiculoides*, the casual alien delta maidenhair fern *Adiantum raddianum* (the first British record, replacing *Cyrtomium falcatum* lost from its previous site) and two records of *Polystichum setiferum*, from Highgate Cemetery where it was presumably planted, and from an urban site in Westminster.

Records since 1997

Table 1 lists all known records of ferns in Metropolitan Middlesex made between 1997 and the first months of 2003. They include those made by the author, those made by others and mentioned in R.M. Burton's compilations of 'Botanical Records' for *The London Naturalist*, records from Hampstead Heath and for Ken Wood kindly provided by Mr Howard Matthews, and some other independent records. I have personally checked most of the early records. The list is certainly not exhaustive; though the coverage of Camden, City of London, Hackney, Islington, and Tower Hamlets is reasonably complete, parts of Haringey and Westminster have been surveyed less thoroughly while the coverage of Fulham and of Kensington and Chelsea is very patchy. However this should not compromise conclusions about the relative abundance of species. Also, the predominant cladding to many buildings in these less-studied boroughs is painted stucco, not, as in other boroughs, bare brickwork on which most wall ferns grow, so it is unlikely that many important records have been omitted.

Ten of the twelve families of ferns native to Britain (one of which, Adiantaceae, is not native in Middlesex), and two families that are not native to Britain, are represented by twenty-nine distinct species or subspecies, of which nineteen are native to Middlesex, and two hybrids. These appear to be the first Middlesex records of *Dryopteris* × *deweveri* and the casual aliens, shaggy wood fern *D. cycadina* and the ribbon ferns *Pteris incompleta* and *P. nipponica*.

Table 2 gives an overview of fern records in the district since 1869. The recent increase in the number of taxa has three main components: an increase in the diversity and, most notably, the abundance and vigour of mural ferns; an increase in woodland species, principally on Hampstead Heath; and an increase in the variety of alien ferns. In the following sections these three groups are treated separately.

Mural ferns

The Aspleniaceae are generally calcicolous ferns growing mostly in crumbling mortar, though *Phyllitis scolopendrium* is equally at home on moist soil banks with little competition and is found in such situations on Hampstead Heath. Kent (1975) listed fewer than a dozen sites, where mature plants were rare; now this fern is as abundant in some parts as male-fern, often large, and nearly always fertile. Though not as plentiful as hart's-tongue, both *Asplenium trichomanes* and *A. adiantum-nigrum* occur in large colonies of robust plants, often together; this is a remarkable change considering that the former was regarded as extinct in the district as early as 1869 while the latter had never previously been recorded. *Ceterach officinarum* is the least common species of the family. Kent, following Salisbury (1927), reported it as extinct but it may never have wholly disappeared from the district. Much earlier Britten (1881) remarked 'Within the last two or three years we have seen specimens brought from a place in the suburbs of London on the Middlesex side of the river . . . where it had previously escaped the notice of the investigators of the flora of that county'. His illustration shows severely impoverished rustyback fronds barely an inch long. And in 1918 J.W. White writes: 'I learn from Mr C.B. Green of Swanage that during his residence in Middlesex he became aware of at least four stations for the fern in the county, in one of which it was fairly plentiful' (White 1918). Today there are four stations in the Metropolitan district alone, where the plants are robust and sporelings frequent.

These changes correlate closely with the removal of sulphur dioxide, SO_2, from London's atmosphere. In solution SO_2 is oxidized to sulphuric acid producing rainfall ('acid rain') with pH values as low as 3.4. Suspensions of droplets in mists can be much more acidic with pH values below 2.75 (Wellburn 1994). 'Occult deposition' of these fine droplets is the most damaging effect of acid rain. London's SO_2 comes mainly from the burning of high-sulphur coal that began in Tudor times, peaked in the late 1950s and fell rapidly as low-sulphur oil

replaced coal following the Clean Air Act of 1956. Regular measurements of SO_2 concentration began in the 1960s but there are sporadic earlier measurements as well as records of SO_2 emission (derived from knowledge of the quantity of coal burnt and its sulphur content) that are an adequate proxy. Table 3 shows the annual mean concentration of SO_2 in central London between 1750 and 1998, measured directly from 1965 and inferred from data on coal consumption before that year. These annualized figures mask the phenomenal levels sometimes reached during Victorian 'pea-soupers' (e.g. 2180 $\mu g\ m^{-3}$ in 1895) and the smogs of the mid twentieth century (e.g. 4100 $\mu g\ m^{-3}$ in December 1962).

Noting that unpolluted air over the Pacific Ocean has SO_2 levels of 0.1 $\mu g\ m^{-3}$ and that concentrations much above 250 $\mu g\ m^{-3}$ are toxic for many plants (Bowen 1974), it is easy to see why London's flora should suffer. It was said in 1865 that 'not a blade of grass would grow' in the garden of the Rectory at Bethnal Green (Brimblecombe 1987). The effect on wall ferns, almost totally dependent on rainfall for nutrients (Page 2000), is likely to be severe. Among the rather few studies of their response to atmospheric SO_2 we cite two. Wada et al. (1987) showed that exposure to air containing about 100 $\mu g\ m^{-3}$ of SO_2 reduced the germination rate of *Adiantum capillus-veneris* spores by an order of magnitude, and led to gross developmental abnormalities, while some effects were still observed at one-tenth the resulting concentration of sulphuric acid in the culture medium. Lawrence and Ashendon (1993) exposed sporophytes of *Polypodium interjectum*, *Phyllitis scolopendrium* and *Dryopteris affinis* to 114 $\mu g\ m^{-3}$ of SO_2 (in combination with NO_2) and found 42 per cent and 26 per cent spore viability in the first two species, respectively. They also sprayed spores with acid mists and found a significant reduction in germination at pH 3.5 and essentially zero germination at pH 2.5. For some species, clearly, a combination of a foggy day favouring occult deposition (see above) and a high level of SO_2 can produce conditions totally inimical to spore viability and development of wall ferns. It is relevant that, for reasons not understood, the incidence of fog in London rose rapidly from 1800, peaked about 1890 and has fallen steadily since (Brimblecombe 1987).

Taking 20–30 $\mu g\ m^{-3}$ of SO_2 as a reasonable threshold for significant damage to fern growth and reproduction (the WHO guideline limit for long-term effects on human health is 40–60 $\mu g\ m^{-3}$) we see from Table 3 that SO_2 first exceeded this level in central London in the early nineteenth century and did not fall below it again until about 1990. In 1870 the area within which sulphate concentrations were 50 per cent or more of the maximum extended from Shepherd's Bush to Woolwich, and from Stoke Newington to Brixton — all of Metropolitan London except the high ground from Hampstead to Highgate (Brimblecombe 1987). This could well explain the almost total absence of mural ferns from the district during most of the nineteenth and twentieth centuries and their recovery in the 1990s.

The Polypodiaceae provide an interesting case study. In his *Historical Flora* Kent stated that all the Middlesex specimens he had seen (a dozen or so, though there were none from the Metropolitan district) were referable to *Polypodium vulgare (sensu stricto)*. In the *Supplement*, *P. interjectum* was admitted for the first time, from Harefield, and there were four new Metropolitan records of *P. vulgare*. Table 1 lists twenty-one recent records of polypody from the district. Nine specimens were infertile or inaccessible but the rest have been examined microscopically (see Table 4). Seven are *P. interjectum*, the annulus of the sporangium having 2 or 3 basal cells and between 5 and 11 (means from 6.5 to 8.8 with errors of 0.2 to 0.3) indurated (thick-walled) cells; see Rich and Jermy (1998) for details of these and other distinguishing features. Five, all from the east of the district, have one basal cell and 9 to 17 (means from 10.5 to 14.7 with errors of about 0.4) indurated cells and are *P. vulgare*. One determination of each species has been expertly confirmed. Assuming that the weak calcicole *P. interjectum* had not been overlooked previously, its appearance in place of the calcifuge *P. vulgare* may be a further consequence of the reduction in acid rain.

Asplenium ruta-muraria is somewhat anomalous, being one of only four ferns present in all lists since 1869 but now apparently scarcer than the other Asplenia. Its persistence for over 250 years in Fulham and over 130 years at Ken Wood may owe something to these places being outside the area of greatest SO_2 pollution. However in the nineteenth century wall-rue was abundant on the wall of Greenwich Park, within the most heavily polluted area (Newman 1854). A major ecological study notes that 'wall-rue is *the* pioneer species of stands of mural vegetation' (Segal 1969; his italics) implying some tolerance of extreme conditions. Like rustyback, wall-rue tends to grow in exposed situations high up on walls and is not often found in shady basements. In any case it is rarely plentiful and in central London does not seem as successful a colonist as Segal reports. In London at least, hart's-tongue is *the* pioneer mural fern.

Woodland ferns

Bracken and male-fern thrive in almost all habitats. Bracken on walls often fails to develop beyond the sporeling stage, the small lacy fronds looking quite unlike mature woodland plants, while mural male-ferns are usually stunted. Male-fern tends to take longer to establish; on bombed City sites bracken was very abundant from 1943 onwards, while male-fern first appeared in 1944 and was still rare nine years later (Fitter and Lousley 1953). However it is now the dominant fern of the built-up area as well as the woodland on Hampstead Heath. *Dryopteris dilatata* is also abundant on the Heath, as is *Athyrium filix-femina* which was previously scarce; two subspecies of scaly male-fern *D. affinis* have been recorded, and narrow buckler-fern *D. carthusiana* is sufficiently plentiful that its hybrid with broad-buckler, *D.* × *deweveri* (see Page (1997) for a description) has been found; *Polystichum aculeatum*, supposedly seen by Edward Hunter in Ken Wood before 1814 (Kent 1975) has not been recorded since but *P. setiferum* is nearby; and *Blechnum spicant* has reappeared. What accounts for these changes?

These handsome ferns were targeted by collectors whose depredations were not restricted to Victorian times, as L.G. Payne plaintively remarked seventy years ago: 'The unpalatable fact has to be faced that many species of native ferns are tending to disappear from localities where previously they were to be found . . . A few years ago we remember seeing a tramp dexterously grabbing up roots of the broad buckler-fern in a Surrey wood, and rapidly filling a sack at his side, one large sack being already full . . .' (Payne 1934). Fifty years earlier, Britten (1881) was hopeful of 'the ravages of collectors . . . being kept in check by the watchful care of the local magistrates, who have determined to preserve the natural flora of the Heath'. Like Whiting after him, Britten was too sanguine; as late as 1949 Kent's forlorn comment on *Blechnum spicant* at East Heath reads: 'one plant; grubbed up a few days after being found' (Kent and Lousley 1957).

But collection is only a partial explanation for scarcity. The woodland we see today is vastly more extensive than it was in Trimen and Dyer's time. Then only Ken Wood was, as it remains, fully wooded. The 1:2,500 Ordnance Survey map of 1866 shows the East Heath as just that — rough grassland, the few trees mainly confined to stream banks. Even these few were too much for Charles Dickens: 'Who planted them? Had he any business to do so? They are an eyesore. Where will they end? . . .' (Dickens 1857). The survey of 1915 shows trees occupying perhaps ten per cent of East Heath. As Mr Vaughan has shown, the dense woodland and wide hedges on the lower ground of East Heath, on South Meadow, and around Cohen's Fields only developed in the second half of the twentieth century (Vaughan 1998). Around the time that collection ceased, suitable habitat for woodland ferns became available, allowing first *A. filix-femina* (1931, according to Kent (1975), though not mentioned by Bishop et al. (1936) or Kent and Lousley (1957)), then *D. carthusiana* (1945) and finally *P. setiferum* (1997) and *D. affinis* (1998) to establish.

How did this happen? Windborne spore dispersal from distant sites is the most likely mechanism and probably accounts for the arrival of *A. filix-femina*,

D. affinis and *D. carthusiana* none of which were previously recorded at their present stations (although the last two may have been present but overlooked, mistaken for *D. filix-mas* and *D. dilatata* respectively). Nor was *P. setiferum* but as this is a horticultural fern often planted in semi-natural situations (as at Tower Hamlets and Highgate cemeteries) the possibility of human agency arises. Both *Osmunda regalis* and ostrich fern *Matteuccia struthiopteris* are known to have been introduced to the Heath, the former deliberately and the latter probably accidentally (Howard Matthews, *in litt.*). Although the two known sites for *P.setiferum* appear quite natural, on sloping stream banks amongst a dripping canopy of other ferns, that at Cohen's Fields is a short distance downstream from a planted specimen in the grounds of Athlone House, whence it probably spread. The plants seen under gratings at East India Dock Basin, where they occur with polypody, lady-fern and spleenworts, certainly colonized this damp shady site without human assistance. It seems likely that the East Heath colony of *P. setiferum* arose from windborne spores, possibly from cultivated plants. The single plant of *P.* × *bicknellii*, its hybrid with *P. aculeatum*, was surely planted as the latter has been long extinct in the district, if it ever occurred.

A third route for establishment *de novo*, and the most intriguing, is regeneration from spore banks stored in the soil. The discovery that viable spores of some (brown-spored) species can survive for many years is relatively recent; examples in the literature include the germination of *Pteris* after twenty-seven years (Dyer 1979), *Asplenium* species after forty-eight years (Hill and Wagner 1974), *Pellaea truncata* after fifty years (Windham et al. 1986), and studies of *Athyrium filix-femina* (Page 1997 and references therein). It is the most likely explanation for the reappearance of *Blechnum spicant* whose spores can apparently remain viable for decades (C. Fraser-Jenkins, pers. comm.).

John Gerarde found *B. spicant* in 1597 'on a heath by London called Hampsteede Heath . . . in great abundance'. It was seen in Ken Wood by William Curtis at the end of the eighteenth century, and by the Vale of Health pond by Alexander Irvine at the beginning of the nineteenth (Kent 1975). Both Daniel Cooper (1836) and Irvine again (1838) give unlocalized records in woodland. Then there is nothing for a hundred years, until the sad story of the one plant found and lost in 1949; but in 1975 Kent made the remark quoted earlier that hard-fern may still exist on the Heath.

At the time of writing six colonies of hard-fern are known to the author. The largest is by the Vale of Health pond beneath a nearly vertical bank where the Bagshot Sand overlies the London Clay. This must surely be where it was seen by Irvine. There is little competition; the bank is eroding and sporeling plants are appearing in the exposed patches. One of the plants is the variety known to early fern-fanciers as *anomala*, namely having fronds fertile in the upper half only, with broad sterile pinnules below. All other plants appear normally dimorphic. This difference in a single colony supports the idea that it arose from a genetically varied spore bank and was not deliberately planted. Howard Matthews points out that the area is well-trodden by fishermen which may have assisted regeneration. A second site is near a fallen tree in Ken Wood, blown down in the Great Storm of October 1987. The ferns were first seen about three years later. There is a compact cluster of several plants but much encroaching bracken. Two further stations in Ken Wood, less than 250 metres from this, were found in 2002: a colony of mature plants on a steep stream bank and a single young plant on a decaying stump. At a fifth site near Viaduct Pond, hard-fern has spread since its discovery in 1998, again at the base of a fallen tree, to a loamy bank nearby. At a sixth station further east, just outside the Ken Wood boundary fence, two sporelings in their first season were found in January 2003. It is tempting to think that spores released from the rootplates of fallen trees were ultimately responsible for at least some of these colonies. Though it is impossible to be sure that none was planted, most were certainly not. Perhaps, as Kent surmised, the hard-ferns that Curtis and Irvine saw have left their descendants after all.

Alien ferns

Doubtless the popularity of small ferns as houseplants has led to their spores escaping and sometimes germinating in the warmth of central London. This explains the temporary appearance on walls of *Adiantum capillus-veneris*, *Cyrtomium falcatum* and *Pteris cretica* which have been known as casuals in Middlesex since 1950, 1966 and 1968 respectively (Kent 1975). London's present climate may suit them better than Kent supposed; one plant of *P. cretica* has been established for twenty years, and sporelings of *A. capillus-veneris* are present at its only current site. Recently, following a succession of mild winters, two semi-tender ferns have been seen in central London, *A. raddianum* in three locations and *Pteris incompleta* in one, all during the second half of 2002. These evergreen ferns are not frost-hardy and it will be interesting to see whether they over-winter successfully at their present sites. In contrast the two alien species of *Dryopteris*, *D. cycadina* and autumn fern *D. erythrosora*, are hardy ferns of which the latter is much grown for ornament.

Discussion

A greater variety of ferns now grows in central London than for at least two centuries. Some perhaps have always been there, but it seems implausible that so many should have been ignored or overlooked. The evidence points to a real increase in diversity. I have argued that cleaner air has allowed mural ferns, both native and alien, to flourish in crumbling mortar. Woodland ferns have returned to Hampstead Heath, which may have more trees now than at any time since the destruction of the woods that blanketed much of Middlesex until the eighteenth century. The urban heat island, aided by a general warming trend, has encouraged the establishment of ferns escaped from cultivation. All this has happened without any deliberate attempt to bring it about.

Many of the factors discussed by Page (2000) in his review of patterns of change amongst pteridophytes come into play here. Ferns tend to occupy marginal habitats wherein new pressures can be the last straw ('beyond the sphere of tolerance' as Page puts it). For example, if reduction of atmospheric NO_2 were to be as successful as reduction of SO_2 (NO_2 levels in central London have fallen by only about 20 per cent in the last twenty years), rainwater would lack the nitrates essential to fern development and mural ferns might decline as rapidly as they have increased. The management regimes on Hampstead Heath that have favoured woodland ferns could be nullified if one of them, bracken, is allowed to get out of control. In 2002 a frond about 5 m high was seen in Ken Wood, a contender for the British record (see *BSBI News* **87**: 43 (2001) and **90**: 29 (2002)) and a warning of what could happen if it is not checked.

Page cites, as a beneficial effect in terms of biodiversity, the likelihood of spontaneous hybridization following exhumation of spore banks, naturally or deliberately. The appearance of *Dryopteris* × *deweveri* has already been mentioned. There is a tension here between schemes that benefit this process by disturbing the ground (such as drainage projects) and the need to maintain the most vulnerable habitats such as shaded mires and stream banks. Fortunately the Heath seems at present to be under sympathetic management.

Mural ferns need protection too. Local environmental agencies have a part to play here, by alerting the public to the biodiversity in their midst (seven different ferns grow on a short stretch of otherwise undistinguished wall near St Pancras Station) and in checking the well-meaning but harmful (to ferns) practice of 'cleaning' walls. Civic gardeners, and contractors employed to maintain open spaces such as disused churchyards, are the worst culprits. They would do better to concentrate on really damaging and invasive plants such as buddleia and ivy. But ferns are surprisingly resilient; when a wall in the City of London was tidied, and the rustyback scraped off, it regenerated within a year and is now (January 2003) more plentiful than before. A further threat is from graffiti 'artists' but

their liberal applications of spray paint have fortunately failed (so far) to eradicate rustyback and black spleenwort at two vulnerable sites (Wurzell 2001).

Conclusion

On the whole the outlook is bright. Continued warming may allow *Adiantum capillus-veneris* and other tender aliens to become established on walls. Lemon-scented fern *Oreopteris limbosperma*, still found near the Heath, could be its next colonist. [Note added in proof: This possibility has already been realized. In August 2003, Howard Matthews found a single plant of *Oreopteris limbosperma* in Ken Wood (Figure 1). Tables 1 and 2 and numerical data in the text have been updated accordingly.] Perhaps *Ophioglossum vulgatum*, seen at Ken Wood as recently as the 1960s (Brian Wurzell, *in litt.*), will reappear.

It is appropriate to quote from the final paragraph of Page (2000): 'By placing emphasis on gaining an ecological and evolutionary understanding of the reasons for change, there is considerable potential in many pteridophytes as relatively sensitive bio-indicators of multiple aspects of change . . . We are likely to find a far greater environmental application of them as sensitive bio-indicators in the forthcoming century than we have in the last.' What is happening in London seems to bear this out.

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TABLE 1: Fern records for Metropolitan Middlesex, 1997–2003.

For species with seven or fewer records, all are cited; otherwise aggregate numbers are given. All sites on Hampstead Heath are within the London Borough of Camden. Records are by the author (JE) unless indicated otherwise: Mr A. Vaughan (AV), Miss B.J. Villiers (BV), Mr B. Wurzell (BW), Mrs C. Hawkins (CH), Mr D. Bevan (DB), Mr D. McClintock (DMc), Mr D. Mitchell (DM), Mrs E. Wiltshire (EW), Dr F. Rumsey (FR), Mr H. Matthews (HM), Mrs D.E. (Johnnie) Slattery (JS), Mr R. Palmer (RP). * indicates taxa alien to Middlesex. Taxonomy and nomenclature for British taxa follow Stace (1997).

OPHIOGLOSSACEAE

Ophioglossum vulgatum L. Westminster: Buckingham Palace Garden, DM 1979; still present 1995–8, DMc and EW (McClintock and Wiltshire 1999).

OSMUNDACEAE

Osmunda regalis L. Camden: East Heath, Hampstead, AV and HM 1998. Westminster: Buckingham Palace Garden since 1959, DMc (McClintock and Wiltshire 1999). Extinct as a native in the district but occasionally regenerating; planted in both stations.

*ADIANTACEAE

**Adiantum capillus-veneris* L. Tower Hamlets: under railway arch at Mile End, 2001; still there with sporelings 2002.

**Adiantum raddianum* Presl. Camden: basement area, Millman St WC1, 2002. Westminster: wall, Cambridge St SW1, destroyed soon after, FR 1997; first British record (Rumsey 1998). Westminster: basement area, Burlington House, Piccadilly, 2002. Westminster: basement area, Glentworth St NW1, 2002.
**Adiantum* agg. Camden: under grating, Fellows Rd NW3, HM 1999.

*PTERIDACEAE

**Pteris cretica* L. Westminster: one plant, front area, Chesham St SW1, RP 1982; still there, 2002.
**Pteris incompleta* Cav. Westminster: several immature plants, basement area, Glentworth St NW1, 2002; det. C.Fraser-Jenkins.
**Pteris nipponica* W.C.Shieh (syn. *Pteris cretica* var. *albolineata* Hooker). Westminster: two mature plants, basement area, North Row, Mayfair W1, 2003.

POLYPODIACEAE

Polypodium agg. 9 records of inaccessible or infertile plants on walls in Camden (5), Kensington & Chelsea (1), Tower Hamlets (2), Westminster (1).
Polypodium vulgare L. Hackney: few plants, Springfield Park, BW 1999 (Burton 2000). Haringey: vigorous clump, Markfield Recreation Ground, BW 2002. Islington: wall coping, Myddelton Passage EC1, 2003. Tower Hamlets: few small plants, wall of former gasworks, Bow Common Lane E3, 2001; det. A.M. Paul. Tower Hamlets: starved plant, Shadwell Basin E1, 2003.
Polypodium interjectum Shivas. Camden: colony of robust plants, wall of 'Old Mitre', Ely Place EC1, 2000; det. A.M. Paul. Camden: many small plants, retaining wall, Ridgmount Gardens WC1, 2000. Camden: wall, Purchese St NW1, 2001. Islington: plentiful on tombs, Bunhill Fields EC1, 2000. Islington: basement area, Sekforde St EC1, 2000. Kensington & Chelsea: one plant, basement area, Elm Park Gardens SW10, 2002. Tower Hamlets: extensive colony, inner wall of East India Dock Basin, 2000. Fronds to 30 cm at some sites.

DENNSTAEDTIACEAE

Pteridium aquilinum (L.) Kuhn. Abundant throughout the district. Wall sites often host small immature forms but fully-developed fertile specimens are common.

THELYPTERIDACEAE

Oreopteris limbosperma (Bellardi ex All.) Holub. Camden: one plant by damp track, Ken Wood, HM 2003 (Figure 1).

ASPLENIACEAE

Phyllitis scolopendrium L. Newman. Abundant throughout, and found wherever other members of the family occur. Present in damp situations, almost always on vertical surfaces, in probably every 1-km square, and on Hampstead Heath by streams on East Heath and Cohen's Fields (HM 1998–9 and JE 2002). Furcate, lacerate and other varieties are common. Fronds to 30 cm, or to more than 60 cm beneath gratings.
Asplenium adiantum-nigrum L. 27 records on walls and graves in Camden (8), City of London (4), Hackney (3), Hammersmith & Fulham (1), Islington (3), Kensington & Chelsea (1), Tower Hamlets (5), Westminster (2). Fronds to 35 cm, variously bi- and tri-pinnate.
Asplenium trichomanes L. ssp. *quadrivalens* D.Meyer. 37 records on walls and graves, often forming dense colonies, in Camden (9), City of London (6), Hackney (3), Haringey (1), Islington (2), Kensington & Chelsea (2), Tower Hamlets (8), Westminster (6). In one Islington site it grows on limestone boulders beside a landscaped section of the New River.
Asplenium ruta-muraria L. 16 records on walls and graves, rarely plentiful, in Camden (5), City of London (1), Hackney (2), Hammersmith and Fulham (2), Islington (2), Kensington & Chelsea (2), Tower Hamlets (1), Westminster (1). At one Islington site it grows with the previous species on limestone boulders by the New River. Still present in 2002 on brick tomb at All Saints Church, Fulham where recorded by Blackstone in 1746 (Kent 1975) and on wall of kitchen garden at Ken Wood where recorded in 1869 (Trimen and Dyer 1869).
Ceterach officinarum Willd. Camden: plentiful on wall, Athlone House N6, AV 1997; still there, 2002. City of London: one plant on Roman wall, St Alphage Gardens, 1997; gone the next year. City of London: small colony on brick wall by All Hallows, London Wall, 1999; increasing in 2002. Haringey: one plant in cracked concrete, Markfield

Recreation Ground, BW 1996; now three plants, BW 2003. Tower Hamlets: one plant on canal wall, Mile End, CH 2001; still there, 2002.

WOODSIACEAE

**Matteuccia struthiopteris* (L.) Tod. Westminster: Buckingham Palace Garden, DMc and EW 1995–8 (McClintock and Wiltshire 1999); possibly planted.

Athyrium filix-femina (L.) Roth. Scattered but not uncommon in damp woodland, Hampstead Heath: South Meadow, Cohen's Fields, East Heath, HM 1998–9 and JE 2002. Urban records are of small but fertile plants, viz. Camden: wall at St George's Gdn WC1, 2001. Tower Hamlets: brickwork beneath grating, East India Dock Basin E14, BW 2002. Westminster: basement area, Margaret St W1, 2001.

DRYOPTERIDACEAE

Polystichum setiferum (Forssk.) T.Moore ex Woyn. Two stations by streams on Hampstead Heath: several plants, East Heath, and one plant, Cohen's Fields, HM 1997; still at both sites, 2002. Camden: under neglected window box, Millman St WC1, 2001; still there 2002. Tower Hamlets: several plants beneath gratings, East India Dock Basin, BW and JE 2002.

Polystichum × *bicknellii* (H. Christ) Hahne. Hampstead Heath: one very large plant with abortive spores by stream under Lime Avenue, East Heath, revealed by scrub clearance, 2003; probably planted.

**Cyrtomium falcatum* (L.f.) C.Presl. Camden: basement area, Russell Hotel WC1, 2001; may not have survived wall cleaning, 2002.

Dryopteris filix-mas (L.) Schott. Ubiquitous. The commonest fern in the district, on walls, in waste ground and woodland, rarely as a colonizer of cultivated ground.

Dryopteris affinis (Lowe) Fraser-Jenk., ssp. *affinis*. Sparse on Hampstead Heath at Parliament Hill Fields, East Heath, and South Meadow, HM 1998–9 (Burton 1999, as *D. affinis*). Tower Hamlets: two plants in a shrubbery at Mile End since 2001.

Dryopteris affinis ssp. *borreri* (Newman) Fraser-Jenk. Sparse on Hampstead Heath at South Meadow, Cohen's Fields and East Heath, HM 1998–9 (Burton 1999, as *D. affinis*); Cohen's Fields, JE 2002.

Dryopteris carthusiana (Vill.) H.P.Fuchs. Occasional in mires beside streams on Hampstead Heath; Ken Wood, HM 1998-9, East Heath, JE 2002.

Dryopteris × *deweveri* (J.T.Jansen) Wacht. Two records from Hampstead Heath; West Meadow, HM 1988–9; East Heath, JE 2002, det. C.Fraser-Jenkins. First records for Middlesex.

Dryopteris dilatata (Hoffm.) A.Gray. Abundant in woodland, Hampstead Heath. Stunted and infertile plants occur rarely on urban walls, viz. Camden: basement area, Russell Hotel WC1, 2000. Camden: wall of St George's Gardens WC1, 2003. Camden: basement area, Bedford Avenue WC1, 2003. Hammersmith & Fulham: wall of South Park, Fulham, 2002. Tower Hamlets: boundary wall, St Paul's Shadwell, 2003. Westminster: basement area, Melcombe St NW1, 2000. Westminster: wall of Limelight Club, Shaftesbury Ave WC2, 2001.

**Dryopteris cycadina* (Franchet & Savatier) C.Christensen. Camden: sterile plant on wall of St George's Gardens WC1, 2001, det. C.Fraser-Jenkins; still there 2002.

**Dryopteris erythrosora* (D.C.Eaton) O.Kuntze. City of London: several plants in former churchyard of St Laurence Pountney, Cannon St EC4, 2002, det. A.M. Paul.

BLECHNACEAE

Blechnum spicant (L.) Roth. Six stations on Hampstead Heath. About twenty mature plants plus sporelings by Vale of Health pond, HM 1998–9; JE 2002 recorded here by Irvine in the early nineteenth century (Kent 1975). Several mature plants by fallen tree in woodland, Ken Wood, JS and BV *c.*1990, reported by HM 1998-9, see also Burton (1999); still there, 2002. Large clump on rootplate of fallen tree in enclosure above Viaduct Pond, JS and BV 1998; still there, and others nearby, 2003. One young plant on decaying stump at path junction north-east of Duelling Ground, Ken Wood, 2002. About six mature plants beside stream feeding Ken Wood lake from west, 2002. Two sporelings on steep shaded bank just outside southern boundary fence of Ken Wood, 2003 (Figure 1).

*AZOLLACEAE

**Azolla filiculoides* Lam. Sporadically abundant in canals etc. Hackney: Lea Navigation at Hackney Wick E9, 1999. Haringey: pond in Stationer's Park N4, DB 2000. Tower Hamlets: Lea Navigation at junction with Hertford Union Canal E3, 2001. Tower Hamlets: Lea Navigation south of Bow Road E3, 2003.

TABLE 2: Ferns recorded in Metropolitan Middlesex since 1869.

References: Trimen and Dyer 1869; Bishop 1936; Kent and Lousley 1957; Kent 1960–7; Kent 1975; Kent 2000; this work 2003.
P indicates recorded as present; the number of sites noted in 1975, 2000 and 2003 is also given (S = several but sparse, A = many and abundant). † indicates not present, or extinct. * indicates taxa alien to Middlesex.

	1869	**1936**	**1957**	**1960–7**	**1975**	**2000**	**2003**
Ophioglossum vulgatum	P		P		P (1)	P (1)	P (1)
Osmunda regalis	P				†	†	P (2)
**Adiantum capillus-veneris*					P (2)	P (1)	P (1)
**Adiantum raddianum*						P (1)	P (4)
**Adiantum* agg.							P (1)
**Pteris cretica*					P (2)	P (6)	P (1)
**Pteris incompleta*							P (1)
**Pteris nipponica*							P (1)
Polypodium vulgare (s.l.)	P						P (9)
Polypodium vulgare (s.s.)					†	P (4)	P (5)
Polypodium interjectum							P (7)
Pteridium aquilinum	P	P	P	P	P (A)	P (A)	P (A)
Oreopteris limbosperma							P (1)
Phyllitis scolopendrium	P		P	P	P (A)	P (A)	P (A)
Asplenium adiantum-nigrum						P (4)	P (27)
Asplenium trichomanes	†				†	P (2)	P (37)
Asplenium ruta-muraria	P	P	P	P	P (4)	P (5)	P (16)
Ceterach officinarum	P				†	P (1)	P (4)
**Matteuccia struthiopteris*							P (1)
Athyrium filix-femina				P	P (3)	P (A)	P (A)
Polystichum setiferum						P (2)	P (4)
Polystichum × *bicknellii*							P (1)
Polystichum aculeatum	P				†	†	†
**Cyrtomium falcatum*					P (1)	†	P (1)
Dryopteris filix-mas	P	P	P	P	P (A)	P (A)	P (A)
Dryopteris affinis ssp. *affinis*						P (1)	P (S)
Dryopteris affinis ssp. *borreri*						P (1)	P (S)
Dryopteris carthusiana			P		P (1)	P (1)	P (S)
Dryopteris × *deweveri*							P (2)
Dryopteris dilatata	P	P	P	P	P (A)	P (A)	P (A)
**Dryopteris cycadina*							P (1)
**Dryopteris erythrosora*							P (1)
Blechnum spicant	P		†		†	†	P (6)
**Azolla filiculoides*						P (3)	P (4)
Number of distinct taxa	11	4	7	6	11	19	31

TABLE 3: Concentration of SO_2 in central London's air 1750–1998.

Year	Mean SO_2 ($\mu g\ m^{-3}$)	Year	Mean SO_2 ($\mu g\ m^{-3}$)
1750	5	1965	305
1800	14	1970	260
1850	56	1975	155
1870	108	1980	55
1900	192	1985	40
1920	216	1990	29
1930	183	1992	26
1940	211	1994	20
1950	263	1996	17
1960	315	1998	9

Sources

(a) 1990–8: Measured at Bridge House, Victoria (DETR 2002); converted from ppb (1 ppb = 2.86 $\mu g\ m^{-3}$).

(b) 1965–85: Measured in City of London (GEMS 1992).

(c) 1750–1960: Derived from total emissions of SO_2 in Britain (Bowen 1974) normalized to (b) for 1965 for which both data sets are available. As SO_2 has a short residence time in the atmosphere this proxy estimate assumes that emissions in London were a constant fraction of national emissions during this period. The ratio in 1965 was about 6 per cent (data for London emissions from GEMS 1992) while it was about 8 per cent at the end of the eighteenth century (derived from data in Brimblecombe (1987) and Nef (1932)). Thus the table may slightly underestimate London's SO_2 levels in the early part of the period.

FIGURE 1. *Blechnum spicant* (left) and *Oreopteris limbosperma* (right) in Ken Wood, August 2003.

TABLE 4. Counts of annular cells in *Polypodium*.

The Table lists the numbers of basal and indurated cells in ripe sporangia from twelve specimens of *Polypodium* from the Metropolitan district. Plants I1-I7 are referred to *P. interjectum*, and V1-V5 to *P. vulgare*. For comparison, C1 shows the distribution of annular cells for a specimen of *P. cambricum* from Spain. In most cases cells on about 20 sporangia were counted, but basal cells could not always be counted reliably so fewer of these are listed.

Number of cells	**I1**	**I2**	**I3**	**I4**	**I5**	**I6**	**I7**	**V1**	**V2**	**V3**	**V4**	**V5**	**C1**
Basal: 1				1				14	11	2	14	6	
Basal: 2	2	2	8	16	3	9	7						
Basal: 3	10	7	2	1	1	6	6						9
Basal: 4													4
Indurated: 4													1
Indurated: 5		3	1										7
Indurated: 6	4	8	4		1		1						9
Indurated: 7	10	2	4	6	1	10	4						3
Indurated: 8	6	5	3	7	5	9	4						
Indurated: 9			9	9		7	9	1		4			
Indurated: 10			1	8		2		4		3			
Indurated: 11				3				2		2	7	3	
Indurated: 12								1	4	2	6	9	
Indurated: 13									5	3	3	3	
Indurated: 14									1	4	3		
Indurated: 15									5	1			
Indurated: 16											1		
Indurated: 17									1	1			
Indurated: 18									1				
Indurated: 19									3				
Mean indurated cells	7.10	6.50	7.82	8.85	7.57	8.04	8.17	10.5	14.7	11.9	12.3	12.0	5.70
Error of mean: ±	0.16	0.26	0.30	0.22	0.30	0.18	0.23	0.33	0.55	0.52	0.30	0.17	0.18

I1: Camden (Ely Place EC1). I2: Islington (Sekforde St EC1). I3: Camden (Purchese St NW1). I4: Islington (Bunhill Fields EC1). I5: Camden (Ridgmount Gardens WC1). I6: Tower Hamlets (East India Dock Basin E14). I7: Kensington & Chelsea (Elm Park Gardens SW10). V1: Tower Hamlets (Bow Common Lane E3). V2: Hackney: (Springfield Park E5). V3: Haringey (Markfield Recreation Ground N5). V4: Islington (Myddelton Passage EC1). V5: Tower Hamlets (Shadwell Basin E1). C1: Barcelona, Spain.

Book reviews

Dragonflies. Steve Brooks. The Natural History Museum, London. 2003. 96 pp. £9.95. ISBN 0 565 09180 8.

Butterflies. Dick Vane-Wright. The Natural History Museum, London. 2003. 112 pp. £9.95. ISBN 0 565 09179 4.

These two titles are welcome additions to the Natural History Museum's Life Series where each volume represents an insight into a particular taxon of plants, animals, or ecosystem. In recent years there has been a plethora of identification guides on both butterflies and dragonflies, which share the distinction of often being of more interest to the general naturalist than the serious entomologist.

For those who wish to delve deeper into the origins, life-cycles and general natural history of these beautiful insects, these two books offer a suitable opportunity. In addition to revealing a wealth of information about their subjects, both books are a delight to handle with a superb selection of first-rate photographs, including familiar British species as well as many exotics; some bringing back memories of foreign trips! It was good to see so many photographs depicting not just the photogenic adults but all stages of the life-cycle. A range of egg shapes for the holometabolous (having a complete metamorphosis) butterflies is illustrated, as well as various larval shots including one of the final instar of a large blue *Maculinea arion* within the nest of a *Myrmica* ant where it feeds on ant larvae and pupae, and a sequence of photographs showing the transformation of caterpillar to chrysalis in the familiar peacock *Inachis io.* A clouded yellow *Colias croceus* is used to demonstrate the emergence of the imago from the chrysalis — one of the marvels of nature.

The dragonflies book similarly has superb shots of hemimetabolous development (incomplete, no pupal stage), with endophytic and exophytic eggs shown, nymphal stages, a stunning photo of a hawker larva with its fish supper, and the sequence of a common darter *Sympetrum striolatum* emerging as an imago from the nymphal case.

Life strategies are well represented. Odonata are carnivorous at all stages and we read about the aquatic ambushes by the nymphs, which under hydraulic pressure shoot out their mask to impale their unsuspecting prey; whilst the adults are supreme aerial predators. I learnt about a Central American family — the giant helicopter damselflies (Pseudostigmetidiae) that specialize in plucking spiders from the centre of their webs! In their turn Odonata also sustain other life forms and one photo shows some damselflies coming to a sticky end on a sundrew *Drosera.* With butterflies the metamorphosis involves chewing larva evolving into a straw-sucking adult. Among the surprises revealed is an apparently aquatic larva of a species of blue endemic to Borneo, frequenting pitcher urns.

Both groups contain some powerful fliers and flight is explored; the mechanics of it, dispersal to find a mate, breeding sites, food resources and migration. The well-documented migration of the monarch *Danaus plexippus* is examined and various questions asked; not all of them have a full explanation.

Communication is given much stronger coverage in *Butterflies* where taste, touch, hearing, vision, smell and the importance of colour are explored. Dragonflies are primarily visual and there are a few paragraphs on this.

A brief introduction is given to the twenty-nine families of Odonata found throughout the world, giving a good insight into their diversity. This is not repeated for the butterfly book; instead we are treated to chapters on variation and evolution. Sexual dimorphism is well known but we also see species which are vastly different according to season, well illustrated in the African *Precis octavia,* racial variation as well as aspects of mimicry and camouflage.

Both books conclude with a conservation theme exploring topics such as the impact of climatic change, human activities and habitat loss and how we can help with habitat protection, creating ponds for dragonflies, and for LNHS members, probably a case of preaching to the converted, the importance of recording.

All in all both books represent great value for money, retailing at less than a tenner, and offer a superbly illustrated insight into the worlds of these two very different but increasingly popular groups of insects.

NEIL ANDERSON

The Natural History Museum's new Darwin Centre has been open for just over a year, and to mark the occasion a small fully illustrated book, *Specimens — the spirit of zoology,* by Roger Lincoln and Phil Rainbow, has been published (ISBN 0 565 09178 6, £5.95). It describes in detail how spirit collections are preserved and curated and how they are studied in relation to taxonomy and biodiversity. The above titles, and many more, are available from the Museum's Bookshop. Ed.

The development of the flora, fauna and environment of the Wildlife Garden at the Natural History Museum, London

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Abstract

This paper presents the latest results of a long-term study of the Wildlife Garden in the grounds of the Natural History Museum, South Kensington. The current study period tracks the development of the garden and species colonization since 1998. It follows the publication of the results from the garden's opening in 1995 through to 1998, published in *The London Naturalist* No. 77, 1998 and No. 78, 1999. The records show changes in both species composition and abundance. In addition, research is being carried out on the effects of pollution on plants, which has important implications for pollution studies elsewhere in London.

Introduction

Background and aims of report

The background and aims of the Natural History Museum's Wildlife Garden (henceforth the garden) have been described (Honey et al. 1998). Underpinning these aims is the continuing study of its flora and fauna. The report published in 1998, followed by the survey of vascular plants (Ware 1999), provided baseline data on species of plants and animals planted in and initially colonizing the garden. Now, five years on from the first surveys, we aim to update these records, incorporating information on additional groups as well as studies on some of the environmental factors.

The purpose of this report is to chart the development of the garden from 1998 to 2002; to report species colonization during this period; and to compare our results of 2002 with those of 1998.

Habitat development since 1998

Development in the garden since 1998 has focused on consolidating plant communities within each of the habitats we are aiming to reproduce. This has included replacing cultivars and plants of doubtful provenance with native species.

Early in 1999 the area of fen was extended. Plant material and fen peat, donated by the Norfolk Wildlife Trust, was collected from Hickling Nature Reserve following excavation carried out as part of habitat management there.

Species collected included common reed *Phragmites australis,* saw sedge *Cladium mariscus,* marsh fern *Thelypteris palustris* and ragged robin *Lychnis flus-cuculi.* Several other species emerged from the peat later in the spring.

Woodland habitats have been improved with plants sourced from threatened woodland in Kent and Northamptonshire. Bluebell *Hyacinthoides non-scripta,* greater stitchwort *Stellaria holostea* and wood millet *Milium effusum* were collected from a landfill site on woodland near Canterbury. In autumn 2000 Mark Loxton of Adams Loxton Partnership arranged for a mini-digger to help a group of volunteers collect a number of woodland plants that were being destroyed for road-widening in Northamptonshire. These included silver birch *Betula pendula,* oak *Quercus robur* and hazel *Corylus avellana*, and ground flora including St John's wort *Hypericum perforatum,* sweet violet *Viola odorata* and dog's mercury *Mercurialis perennis*. Areas of bluebells have also been extended each year thanks to the supply of bulbs from gardeners at the National Trust's Scotney Castle estate.

The donation of several large alder logs from Coed y Cerrig NNR in March 2002 added to the bryophyte, lichen and fungi list in the woodland, though the pollution-sensitive lichens *Cladonia chlorophaea* and *Cladonia coniocraea* survived no longer than six months.

In February 2001 an expedition to a private estate at Nettlecombe, Somerset, collected more ferns including broad buckler fern *Dryopteris dilatata*, hart's tongue *Phyllitis scolopendrium* and soft shield-fern *Polystichum setiferum.* These have been added to the woodland and around the waterfall.

With the help of Freightliners City Farm, the grassland has been grazed by sheep annually in late summer since 1999 — except for 2001 due to foot-and-mouth disease restrictions. Thanks to the generosity of an anonymous donor, the garden now has its own flock of three sheep, working in partnership with the London Wetland Centre at Barnes.

In late summer 1999 Common Ground Community Orchard officer, Dan Keech persuaded us to create an orchard. The area chosen had been disturbed following borehole excavation. Apple trees were purchased from Allgrove Nurseries. Jim Allgrove advised us on the most appropriate three cultivars: The Reverend Wilks, Brownlees Russet and Arthur Turner. The six-year-old trees were planted in March 2000. Meadow buttercup *Ranunculus acris*, yarrow *Achillea millefolium*, bird's-foot trefoil *Lotus corniculatus* and common sorrel *Rumex acetosa* were added to the existing grassland.

The meadow areas are continually worked on by the removal of weedy and invasive species and the addition of meadow species including yellow rattle *Rhinanthus minor* and red bartsia *Odontites verna,* which being semi-parasitic should help to reduce the rye grass *Lolium perenne.* The meadow has been further improved by the addition of a five-bar field gate, donated and installed by Glendale Countryside, and more recently a chestnut field-gate and fencing.

Orchids kindly donated by RBG Kew (Micropropagation Unit) were introduced and planted in the chalk downland and heathland in March 2003. Pond management aims to create optimum conditions for amphibians and invertebrates, sometimes at the expense of the less visible but equally valued algae. Conditions favourable to blanket weed *Cladophora glomerata* were successfully avoided from 1999 to 2001 but returned in April 2002, possibly due to the combination of high nutrient level and very warm weather before the growth of the submerged aquatic plants.

A second platform was built in April 2000 to accommodate the increasing number of school pond-dipping sessions. The boardwalk through the fen was extended in 2001, completing the circular walk around the garden. The garden is managed sustainably and we aim to demonstrate examples of countryside management such as grazing, coppicing and hedge-laying. The material generated from our woodland and willow areas is used to create 'dead' hedges for stock-proof fences and boundary changes. Compost is made from all soft green waste.

Monitoring methods

FLORA and FUNGI

Vascular plants

Plant recording takes place formally each year in most of the main habitats subject to volunteer availability. Species are identified and abundance recorded in each plot following the method set up in 1995: 1–10, 11–50, 51–100 and >100.

Monitoring also takes place informally by regular observation. First and unusual flowerings are noted as they appear. Additions are recorded as they are introduced. All records are entered on the database (see below).

Additional data were collected from the chalk downland meadow (G01) and analysed by Sean Hanna in 1998 and May 2003. Five quadrats each (0.5 × 0.5 m) were randomly placed on the south- and north-facing sides of the downland. Quantitative values were entered for all vascular species using the Domin scale of cover, together with average sward height and percentage cover of bare earth. The data were analysed using the Twinspan classification program. This classifies samples based on the relative similarity of their species composition. The data were then compared to the National Vegetation Classification (NVC) grassland communities (Rodwell 1992) using the MATCH program.

Cryptogams and fungi

The ponds were surveyed for freshwater algae on various dates between May and October 2002. Sample methods were as described in Honey et al. 1998. Soil samples were viewed using a scanning electron microscope to reveal micro-organisms. Algae were then isolated into clonal culture for laboratory identification and experimentation.

All three ponds were surveyed for algae between May and August 1997 and May and November 2002, with casual observations at other times. Other sites sampled include the reed bed (R01/2/3), ford and waterfall (A10). The reed-bed often dries out when the pond level is low and ford area often has small puddles when water is not cascading down from the upper pond. Trees have been examined for subaerial algae and samples collected from damp soil close to the main pond. Material was examined and photographed whenever possible in the living state. Otherwise the samples were preserved immediately using Lugol's solution or 4 per cent formalin.

Detailed surveys of bryophytes were carried out in spring 2001 and spring 2002, with additional casual observations throughout the survey period.

Recording of microfungi started in 1997. Since 1999 there has been at least one specialized visit a year, usually in late summer or autumn. In addition to the recording of pathogens and other microfungi by Elizabeth Mordue, fungi have been recorded by Brian Spooner during four visits between October 2000 and December 2002.

Regular lichen surveys have been carried out in addition to two lichen monitoring projects:

a) Ten permanent quadrats (10 × 15 cm) were established in December 2000 on rock and brick substrata where *Xanthoria parietina* occurred to assess changes in lichen communities over time. Quadrats were photographed at intervals of six months or more.

b) A project was funded by the Department for Environment, Food and Rural Affairs (DEFRA) (Anon. 2002) to examine the effect of traffic emissions on lichens on transplanted twigs across a pollution gradient. Atmospheric monitoring gauges were set up by Sarah Honour (Imperial College) as part of a larger survey to monitor the effect of urban air pollution on vegetation, to monitor pollutants of nitrous oxide, ozone and particles along a transect from Cromwell Road into the garden.

Sycamore *Acer pseudoplatanus* was used as the source of twigs in order most closely to approximate the high bark pH of London plane *Platanus* × *hispanica*. Twigs from a relatively exposed tree with well-developed lichen communities including fruticose and foliose species were collected from a clean-air site at Nettlecombe, Somerset and mounted on plastic posts: two at Nettlecombe and five in the Wildlife Garden. Rainfall and temperature are recorded at Nettlecombe but there is no on-going atmospheric monitoring. The five sites in the garden were arranged in a transect from 20–120 m from the road and close to the existing atmospheric monitoring gauges. Lichens were exposed during the winter season to minimize microclimate variations due to heavy shading in summer by London plane trees. At each site thalli in three different lichen groups were recorded at monthly intervals using a digital camera: *Ramalina* and/or *Evernia* (SO_2 sensitive) and *Parmelia sulcata* (SO_2 tolerant) and *Xanthoria parietina* (N tolerant). Changes in species frequency according to three size classes were recorded for *X. parietina*, *P. sulcata*, *Evernia prunastri* and *Ramalina farinacea*. In addition, at the beginning and end of the experiment chlorophyll fluorescence was measured, in order to assess the vitality of the algal component of each lichen, in at least six *P. sulcata* thalli at each station in the garden and at Nettlecombe on moistened previously dark-adapted thalli.

FAUNA

Aquatic invertebrates

Sampling for macroinvertebrates followed the methods decribed in Honey et al. 1998 and identified mainly with reference to Fitter and Manual (1986). Samples for microinvertebrates were collected at approximately monthly intervals throughout the year using a 16 cm diameter net of 16 cm depth with receiving tube and constructed from nylon silk with a mesh size of 40–65 μm and mounted on a two-metre handle. All samples were examined under the compound microscope within twenty-four hours while the organisms were still alive, firstly under a low power (×30), individual specimens being identified to species under powers of ×100–400. The trophi (jaws) of rotifers were examined where necessary under a power of ×1,000 using an oil-immersion lens. Portions of aquatic macrophytes also examined microscopically for sedentary rotifers. Samples were later preserved for further study in 2–4 per cent formalin. Colleagues and members of other organizations occasionally collect other samples. All records of adult dragonflies are of field identifications. Checks were included for Bryozoa, Porifera and hydra.

Terrestrial invertebrates

Tardigrades

The garden has been sampled twice for tardigrades, firstly in March 1998, when five moss samples were collected. At the time mosses had not yet become extensively established and sampling was restricted to minimize damage. Secondly, in September 2001 a more representative sampling was possible, with samples from nine moss stands.

Blowflies

The blowfly (Diptera: Calliphoridae) population has been monitored since December 2000, with a view to establishing a regional data set on blowfly ecology for the London area, and in particular winter flight activity for these forensically important flies.

Flies were trapped using an odour-baited sticky trap, which comprised a sticky target (30 × 30 cm) secured on a wooden platform 30 cm above ground

level and fitted with a rain cover. The odour source comprised 30 g of a 60:40 mix of minced liver and 10 per cent sodium sulphide solution held in a small plastic bottle positioned centrally on the sticky target. The trap was positioned in shade, under an area of mixed shrubbery in the north-east corner of the garden (P3) and run for twenty-four hours once every two weeks.

LEPIDOPTERA and COLEOPTERA

Monitoring has continued following the methods described in our earlier paper (Honey et al. 1998). Beetles have also been monitored from light-trap and pitfall-trap samples, casual observation and searches by staff of the Dept. of Entomology, NHM, and two underground traps monitored by Richard Thompson for subterranean beetles. In addition, a series of pitfall traps, consisting of eighteen small plastic beakers set into the ground and containing a mixture of antifreeze and detergent, has been set in groups of three in various habitats, together with a control site just outside the garden in a grass lawn. The traps are set each season, volunteer time allowing, left in place for a few days and then emptied and sorted into 80 per cent alcohol for identification. The relevant specialists identify spiders, millipedes, beetles, ants, slugs and snails, flies and other orders.

OLIGOCHAETES

Earthworms were sampled by applying a concentrated solution of washing-up liquid to a quadrat 0.36 m^2. Earthworms, irritated by the solution, were brought to the surface and then transferred to vials containing alcohol to preserve them prior to identification. Samples were taken in January and March 2003.

Vertebrates

Following the methods of Atkins and Herbert (1997), Nick Meade from Froglife carried out a survey of the ponds on 15 April 2002, including a daytime spawn count plus a night-time survey for newts. Although no formal surveys were carried out between March 1997 and 2001, informal observations have been recorded, particularly with regard to the amount of spawn and the appearance of the first froglets of the season.

Birds are monitored early in the mornings and during lunchtimes on a regular basis. Squirrels are monitored by lunchtime observation. Casual observations are also recorded. Overnight surveys have been undertaken for bats using bat detectors, once during the spring and autumn of each year.

Hair-traps have been set up to monitor small mammals. With this method, a fur sample is snatched from mammals passing through a small tube, baited with peanut butter. The collected hair is then compared with samples from our collection of small mammals. The following areas have proved to be the most suitable: Fen (F01), Chalk downland (G01), Oak woodland (W05), Wet heath (LH03), Scrub (S02) and Hedgerow (H02). As with other groups, these records are supplemented by casual observations.

ENVIRONMENT

Water chemistry

Samples of water from each of the three ponds, the reservoir tank and the rain precipitator placed at the bridge between the main pond and lower chalk pond, have been taken on a monthly basis and the water chemistry monitored. Based on readings taken in March 2003, the main pond now has a pH of 8.0, the upper pond 7.6 and the lower chalk pond 8.0. Occasionally during dry weather the water in the reservoir tank has had to be topped up with mains water to maintain the level of the ponds.

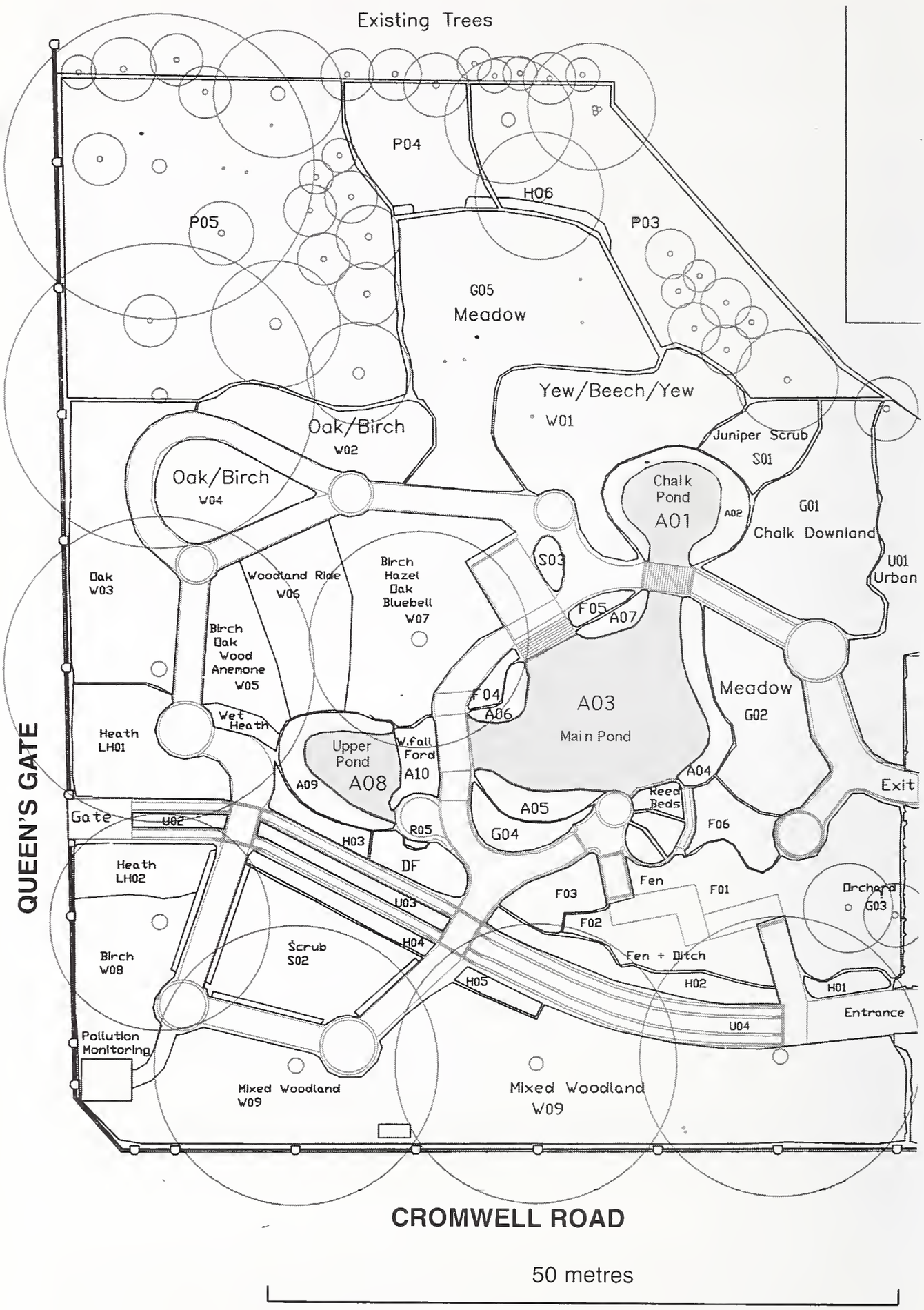

FIGURE 1. Plan of the Wildlife Garden with the various habitat areas and their revised codes.

FIGURE 2. The main pond (A03) and reedbed (R01), May 2003.

FIGURE 3. The main pond (A03) towards Queen's Gate, showing the waterfall (A10), January 2003.

FIGURE 4. The meadow (G05) in winter, after the season's grazing, January 2003.

FIGURE 5. The hedge (H04) bordering the ancient lane (H02–4), June 2003.

FIGURE 6. The chalk pond (A01) and chalk mound (G01), August 2003.

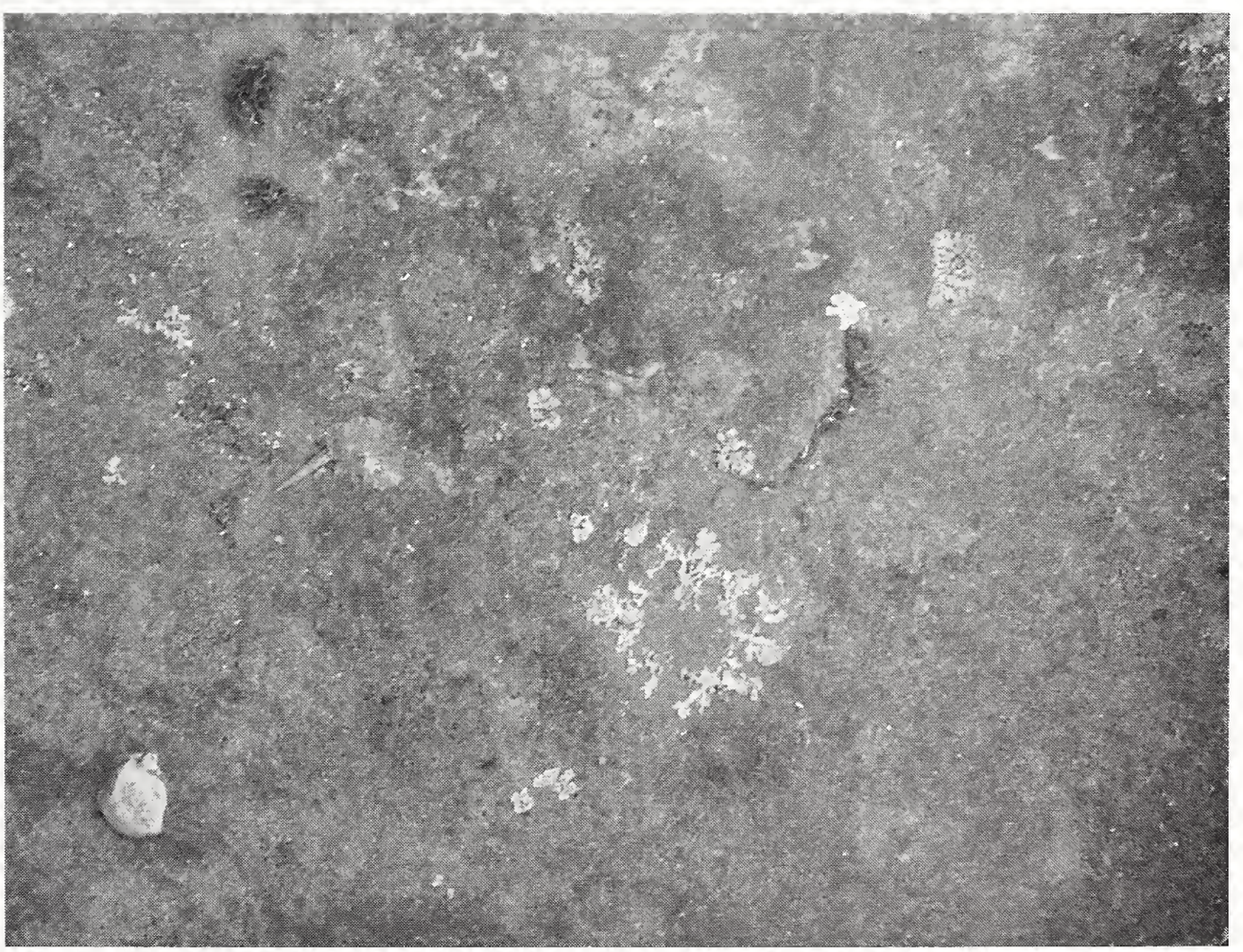

FIGURE 7. *Xanthoria parietina* in lichen quadrat no. 9, August 2002, showing loss of older central parts of thallus.

Air quality

DEFRA

Throughout this survey period DEFRA has had a monitoring hut in the south-west corner of the garden, housing equipment which monitors levels of sulphur dioxide, carbon monoxide, nitrous oxides and occasionally lead and ozone. These results are available from NETCEN who are contracted to run the site, (www.aeat.com/netcen/airqual/data/sitelon.html), as well as the DEFRA website (www.defra.gov.uk). They are also transferred directly to the Wildlife Garden database on a daily basis. This monitoring station replaced a previous site further west along Cromwell Road.

Royal Borough of Kensington & Chelsea Environmental Health Department

RB Kensington & Chelsea monitor the levels of particulates from the same hut. This information is automatically transferred to the Museum's database on a weekly basis and some is also published in the Borough's Pollution Information Bulletin.

Studies on the effects of pollution on plants

Studies have also been carried out to investigate the effects of pollution on plants. One, instigated by the NHM Botany Dept., using lichen on twigs, has been described above, and the results discussed later in this report. Two further studies carried out by Sarah Honour, Imperial College University of London, and Anja Tremper, University of Hertfordshire are described below.

Rocks

The rock types in the garden were identified on 4 March 2002, and these are listed according to locality with the species lists at the end of this report. This information is of interest not only for the geology but also in relation to the substrate of lichens and bryophytes.

Databasing

Every species recorded in the garden is entered onto the Wildlife Garden database. This has recently been modified by staff of the Information Technology section and volunteers, and is currently undergoing further updating to improve efficiency. The map and habitat reference codes have also been revised (Figure 1). Information from this database is also being interpreted for the general public to be made available on the Wildlife Garden website (www.nhm.ac.uk/garden).

Discussion of results

FLORA and FUNGI

Freshwater Algae (David M. John and Peter V. York, Dept. of Botany, NHM)

In 1994 the three butyl-lined ponds (A01, A03, A08) were filled with borehole water supplied by Anglia Water. The main supply of rainwater is supplemented with tap water during hot, dry weather.

The characteristic mats of the water net *Hydrodictyon reticulatum* developed in August and September 1996 within the shallow area of reed bed (R01/2/3) of the large pond (A03). During warm summers in the 1990s its distinctive mats were a common feature of ponds, lakes and slow-flowing rivers in England (John et al. 1998). It remained confined to this reed bed whereas other filamentous green algae (principally *Oedogonium*) accounted for the floating mats elsewhere. During September 1998 a considerable drop in water level occurred and the mats of the water net quickly decayed once left stranded. It has not been recorded again here and the mats that develop in April each year consist of the filamentous green algae *Oedogonium, Spirogyra, Mougeotia* and the blanket weed *Cladophora glomerata*. The first three genera have not been

sampled in the fertile condition hence cannot be identified to species. These mats are removed periodically by raking in an attempt to reduce nutrient levels and to prevent the excessive shading of the submerged vegetation. They usually begin to decline in September and have almost disappeared by October. Some unsuccessful attempts have also been made to control them using bales of barley straw.

Most plankton samples contain relatively small numbers of algal cells and taxonomic diversity was generally low. One reason for the low concentration of planktonic algae might be the high numbers of grazing animals sometimes present, especially the water flea *Daphnia*. It was very abundant in many samples collected in summer 2002, especially in the main pond (A03) and the chalk pond (A01). Often records are based on examination of few cells discovered in a sample and therefore chance is an important factor. Hence it is only possible to comment on seasonality in those cases where an alga occurs in reasonable quantity. An unusual algal phenomenon was observed during a period of calm weather in September and October 2002 when floating mats of green algae had almost completely disappeared from the ponds. The surface of the ponds during these months had a somewhat golden iridescence or sheen that varied in colour depending on the angle it was viewed and the degree of shading. The phenomenon was caused by a chrysophyte that has been identified provisionally as *Chromophyton rosanoffii,* an alga known to form a single-layered surface film. The golden reflection is caused by the chloroplasts in the cells all becoming positioned at the same angle to the sun. Other oily films amongst the marginal aquatic vegetation probably have a bacteriological origin. During the warmer summer months an orange or reddish discoloration of the water in the marginal shallows within the chalk pond was caused by large concentrations of *Euglena sanguinea,* a single-celled flagellated alga whose green-coloured chlorophyll pigments become masked by the presence of a red carotenoid pigment.

The findings of a freshwater algae survey in 1997 were reported in Honey et al. (1998). At that time the pond system had only been filled for two summers and yet more than 30 species (excluding diatoms) were discovered. In a survey from May to November 2002, 56 species were found, including 42 new taxa but excluding 16 from the original list in 1997, the majority of which were green algae. Algal diversity in the ponds was least in the more shaded upper one (29 taxa), followed by the chalk pond (38 taxa) and then the main pond (44 taxa, including the reed bed area).

The ford and waterfall area (A10) was not sampled in 1997. Water rarely cascades down the limestone wall. Frequently at its base there are shallow puddles and the soil next to the main pond is often moist and shaded by vegetation in summer. Sometimes a diverse assemblage of algae has been discovered in these puddles with many species yet to be recorded in the ponds. Flagellates are especially common and include several euglenophytes, a group most frequently associated with detrital material in shallow ponds and lake margins. In a sample collected in November 2002 over 60 algae (including 32 diatoms) and protozoans were recorded by Drs Hilary Belcher and Erica Swale (in litt., 10 December 2002). One of the protozoans was the very rare colourless flagellate *Gyromitus disomatus*. In August and September 2002 dark green, spongy mats of the yellow-green alga *Vaucheria* developed on the damp mud adjacent to the puddles. The garden has existed for over eight years and almost all of the 90 or so algae (excluding diatoms) so far found occur in the ponds and adjacent habits. The only algae present prior to the creation of the garden would have been the ubiquitous subaerial green alga *Desmococcus olivaceum,* which forms the powdery green verdure commonly seen on tree trunks and other surfaces. It is unlikely that the borehole water used to first fill the ponds, and mains water later used for topping up, would have been a significant source of algal innoculum. It is more likely that most algae were introduced inadvertently on water plants and animals, especially on birds and on frog and toad spawn

that has been introduced from time to time. The water net *Hydrodictyon reticulatum* might well have been carried in on water plants, possibly *Phragmites*, since it was closely associated with the reed beds in the main pond and appeared shortly after they were replanted in 1996. Freshwater algae are also commonly dispersed in air currents (Kristiansen 1996) and therefore some might have been blown in with dust particles or transported in rain droplets. Rainwater collected from the Museum roofs might be an important source since it is one of the sources of water for the ponds.

Dispersal of aquatic and terrestrial algae is unusually effective so the range of algal taxa and diversity will be expected to increase with time. One of the principal factors governing the composition of the alga flora in the ponds is water chemistry. The use of mains water to top up the ponds almost certainly accounts for the relatively high levels of nitrate and phosphate that are leading to the excessive growth of filamentous algae (Honey et al. 1998: 20, 21). There are differences in water chemistry between the three ponds with the lowest pH in the more shaded upper pond (A08) where algal biodiversity is least (29 taxa to date). The situation in the main pond (A03) is complicated since it receives water and hence algae from the upper pond. Information is insufficient at present to make more than general comments on algal seasonality and floristic differences in the composition of the algae. To understand the biology of the algae in the ponds will require a more rigorous monitoring programme with regular sampling throughout the year and quantifying the data collected. Serious consideration will need to be given in future to management since any artificial manipulation of the ponds inevitably impacts upon the algal flora and other biological components of these habitats.

In the species lists for freshwater algae most of the major taxonomic groups are represented except for the Bacillariophyta (diatoms). Classifications follow John et al. (2002).

Soil algae (L. Elliot Shubert, Dept. of Botany, NHM)

Two 'transplanted' habitats in the Wildlife Garden, the lowland heath (acid soil) and chalk down (alkaline soil) were compared. The soils were viewed with the scanning electron microscope (SEM) and the soil structures were quite different (fine textured for heath and rough textured for chalk). The below-ground vegetation in the lowland heath was dominated by a variety of green algae (*Characium* sp., *Chlorococcum humicola, Chlorella* sp., *Chlorosarcinopsis* sp., *Elakatothrix inflexa, Klebsormidium flaccidum, Schizochlamydella delicatula, Stichococcus bacillaris, Tetracystis pulchra*) and a diatom (*Luticola mutica*), and the chalk down was dominated by a variety of blue-green algae (*Anabaena circinalis, Chroococcus* sp., *Nostoc commune, Oscillatora limosa, Oscillatora splendida, Pseudanabaena* sp., *Synechoccoccus*) and a diatom (*Navicula* cf. *vaucheriae*).

Future research will investigate the original sources of the lowland heath and chalk down soils to determine if the soil algal populations are similar and have not changed since 'transplantation'. Algae are being isolated into clonal culture for laboratory experimentation. The ecological relationship between plant roots and the soil algae needs further investigation.

Vascular plants (Caroline Ware, NHM)

Over 360 taxa including microspecies and subspecies were identified during the period May 2002 to May 2003. The results are summarized in Table 1 showing comparable results for the 1998/9 survey. A list of all vascular plants recorded in this period, arranged alphabetically by family appears later.

There are three categories of plants: remnant plants, deliberate introductions and accidental arrivals (Honey et al. 1998: 24) though there has been a shift within these categories since 1998. The large remnant plants that remain from the previous garden such as London plane *Platanus* × *hispanica*, Lombardy poplars *Populus* cv and small-leaved lime *Tilia cordata*, are long-term residents,

TABLE 1. Number of plant species by habitat type.

Habitat	Code	No. of species 1998/9	No. of species 2002/3
Woodland	W01–W09	173	191
Scrub	S01–S02		
Hedgerow	H01–H06	107	129
Grassland	G01–G05	166	152
Heathland	LH01–LH03	42	52
Wetland (ponds and banks)	A01–A10 F01 R01–R03	113	74
Fen and reedbed	F01–F04 R01–R03	101	76
Urban	U01	29	61
Total number of species in all areas (not sum)		324	360

while ornamental shrubs, including garden privet *Ligustrum ovalifolium* and mock-orange *Philadelphus coronarius*, have been gradually removed from the garden's southern boundary but remain as valuable bird cover in the north of the garden (P03, P04, PO5). The rate of introduction of new species, from a number of different sources in southern Britain, has been reduced as our own plants reproduce. The accidental arrivals continue to include surprises. Some of the main changes since 1998 are discussed within the context of the developing habitats in the garden.

Woodland

The development of woodland areas (designed to represent lowland mixed broad-leaved woodland) is necessarily restricted on a small site that includes habitats with light-demanding species. Tree planting and removal inevitably take place side by side. Many of the faster growing species such as silver birch and ash *Fraxus excelsior,* planted between 1994 and 1996 as whips or small standards, have been coppiced, pollarded or transplanted to other sites in London. Ongoing planting includes whips of most tree species, and many trees are already self-seeding including field maple *Acer campestre* and pedunculate oak.

Most of the native British tree species are now represented in the garden. A recent gift of a wild service tree *Sorbus torminalis* was planted in area W02.

The shrub layer in all woodland areas is dominated by hazel providing excellent coppice material for practical workshops and demonstrations as well as for fencing and 'dead' hedges. Most of the hazel cultivars have now been replaced with plants of native provenance. Other shrubs around woodland edges provide structure, colour and food for birds and insects. These include guelder rose *Viburnum opulus*, wayfaring tree *Viburnum lantana*, elder *Sambucus nigra*, gorse *Ulex europaeus,* broom *Cytisus scoparius*, spindle *Euonymus europaeus,* dog rose *Rosa canina* and, since 2001, buckthorn *Rhamnus cathartica,* alder buckthorn *Frangula alnus,* and field rose *Rosa arvensis.*

The distinct sub-communities in W05 and W07 of bluebell *Hyacinthoides non-scripta* and wood anemone *Anemone nemorosa* respectively have retained their identity –wood anemone especially is increasing. The woodland glade (W06), planted with additional bluebells in 2000 is, with the spread of wood anemone and red campion *Silene dioica,* especially attractive in late spring. Primroses *Primula vulgaris* followed by ramsons *Allium ursinum*, garlic mustard *Alliaria petiolata* and yellow archangel *Lamiastrum galeobdolon* provide spring cover over an area (W02) previously dominated by fleabanes (*Conyza* species) and

nipplewort *Lapsana communis*. Other species thriving in the northern woodland areas include greater stitchwort *Stellaria holostea*, woodruff *Galium odoratum*, wood millet *Milium effusum*, false brome *Brachypodium sylvaticum*, wood sage *Teucrium scorodonia*, bugle *Ajuga reptans* and dog's mercury *Mercurialis perennis*. Efforts to maintain foxgloves *Digitalis purpurea* in W02 have been thwarted, as soil conditions have proved too base-rich. However they have self-seeded on the heathland (LH01 and LH02) and randomly in corners of the garden. Regrettably, pignut *Conopodium majus*, planted in 2000, did not survive beyond one season. One unexpected accidental arrival, asarabacca *Asarum europaeum*, which possibly arrived with plants from Hazelbrough Wood, has remained in its new habitat (W04) for three years.

Until 2001 ferns were concentrated in W09. In 2001 male fern *Dryopteris filix-mas*, scaly male-fern *Dryopteris affinis* ssp. *borreri*, and broad buckler-fern *Dryopteris dilatata* were introduced in W03 along with soft shield-fern *Polystichum setiferum* in W07 as well as sedges, pendulous sedge *Carex pendula* and wood sedge *Carex sylvatica*, which provide interest and structure after the spring flowering season in spaces previously occupied by *Chenopodium* and *Conyza* species.

Species originally planted in other habitats have also colonized the woodland — some too profusely. These include wild angelica *Angelica sylvestris*, great willowherb *Epilobium hirsutum*, and very recently stone parsley *Sison amomum* which is proving difficult to weed out. The woodland bordering Queen's Gate and Cromwell Road receives greater disturbance in autumn when London plane leaves are cleared, and establishment of spring woodland ground flora has been less successful than in the north of the garden. Along the edges of W08 and W09 cow parsley *Anthriscus sylvestris*, red campion, false brome, wild garlic and nettle-leaved bellflower *Campanula trachelium* perform well.

The woodland community of beech *Fagus sylvatica* and ash (W01) provides welcome shade for our sheep. In spite of the grazing, both dog's mercury and ramsons continue to spread. Additional trees in this chalk woodland community will need to be removed in the coming winter to reduce shading of the meadow (G05).

Scrub

Of the two main scrub areas chalk scrub S01 is losing its identity, mainly for practical reasons as it lies between the meadow (G05) and chalk downland (G01). Yew, *Taxus baccata* planted in 1998, has been moved, as it is poisonous to sheep. Juniper *Juniperus communis*, however, remains on the base of the chalk downland. Other shrub species, including hawthorn *Crataegus monogyna* and spindle, are surviving in spite of supplementing the sheep's diet.

Scrub area S02 in the south of the garden has had little intervention and provides an illustration of succession. The dominant species is bramble *Rubus fruticosus* agg. of which three microspecies have been identified by David Allen: *Rubus* 'False *crespignyanus*', *Rubus polyanthemus* Lindeb. and '*Rubus euryanthemus* W.C.R. Watson'. Other species include self-seeded goat willow *Salix caprea* and crab apple *Malus sylvestris*, self-seeded plants from the remnant ornamentals, rosebay willowherb *Chamerion angustifolium* and ivy *Hedera helix*.

Hedges

It is tempting to increase the number of linear habitats such as banks and hedges and wherever there is space available we do so. The main laid hedges H02 and H04 are pruned back hard in winter and have increased in shrubbiness sufficiently to accommodate nesting blackbirds. Hedge H02 although recently thickened with additional plants, is still gappy in places but was nested in for the first time last year. Hedge, H06, planted in January 1998, forms a bushy barrier between the meadow and composting area. More recently hedges were planted behind the urban area U01 and bordering P03, the latter in preparation for

expanding the meadow. All hedges are mixed species including hawthorn, blackthorn *Prunus spinosa,* field maple and dog rose. In addition, 'dead' hedges provide stock-proof fencing, nest sites and dead wood for insects. Many of our woodland ground flora species also grow in the hedgebanks along with tufted vetch *Vicia cracca,* traveller's joy *Clematis vitalba* and hedge bindweed *Calystegia sepium.*

Grassland

Chalk downland. The number of species recorded in 2002 was 79 compared to 72 in 1998. This includes shrubs on the shadier north and east-facing slopes, and water figwort *Scrophularia auriculata* and ragged robin *Lychnis flos-cuculi* along the stream, which runs down the west-facing slope into the chalk pond. Changes in the dynamics of the grassland community over the past four years are illustrated in Table 2.

TABLE 2. Dominant and abundant plant species in chalk downland, 1998 and 2002.

1998 Dominant species > 100 plants	**1998** Abundant species 51-100 plants	**2002** Dominant species > 100 plants	**2002** Abundant species 51–100 plants
Achillea millefolium	*Agrostis capillaris*	*Anthylis vulneraria*	*Agrostis stolonifera*
Festuca rubra	*Galium mollugo*	*Arrhenatherum elatius*	*Cynosurus cristatus*
Leontodon hispidus	*Galium verum*	*Festuca rubra*	*Festuca ovina*
Leucanthemum vulgare	*Origanum vulgare*	*Galium verum*	*Holcus lanatus*
Lolium perenne	*Plantago lanceolata*	*Leontodon hispidus*	*Origanum vulgare*
	Scabiosa columbaria	*Lotus corniculatus*	*Primula veris*
		Plantago lanceolata	*Rhinanthus minor*
			Sanguisorba minor

It is already known that oxeye daisy *Leucanthemum vulgare* loses the intensity it holds for the first two or three years after sowing as other species take over (Gilbert and Anderson 1998), and on our chalk oxeye daisy declined from > 100 up to and including 1999 to 51–100 in 2000 and 2001, to 11–50 plants in 2002. Yarrow has likewise declined. Species that have taken over include the legumes kidney vetch *Anthyllis vulneraria* and bird's-foot trefoil, as well as false oat-grass *Arrhenatherum elatius*; the last, signifying lack of management, appeared mainly to the rear of the chalk mound — an area ungrazed until September 2002. Rough hawkbit *Leontodon hispidus* continues as a dominant. NVC Survey analysis shows that our downland is beginning to resemble the NVC chalk downland community CG2 *Avenula pratensis-Festuca ovina* that we are seeking to create. Rye grass *Lolium perenne* has declined in abundance, perhaps due to the increased coverage of yellow rattle *Rhinanthus minor*, sown for the first time in 2001. Cowslips *Primula veris* have greatly increased on the downland. Wild marjoram *Origanum vulgare,* salad burnet *Sanguisorba minor*, small scabious *Scabiosa columbaria,* and fairy flax *Linum catharticum* provide colour at the other end of the spectrum. An unexpected and welcome arrival in May 2000 was grass vetchling *Lathyrus nissolia* which has since apppeared annually. This species, more commonly found on coastal grazing marshes in the South-East, has cropped up unexpectedly in other areas of London including the former William Curtis Ecological Park (Smart 1989), and was successfully introduced to The Meadow, Hyde Park in 1988/9 (Wiltshire 1994). Its small magenta flowers are a welcome sight in May. Common centaury *Centaurium erythraea* also arrived on its own — in 1999 — its minute seeds possibly surviving in the chalk introduced from a disused quarry in Hampshire.

In spring 2003 common spotted orchid *Dactylorhyza fuchsii* was planted on the south-facing bank and marks the beginning of a project with RBG Kew to introduce orchids to the garden. Grasses and sedges include sheep's fescue

Festuca ovina, crested hair-grass *Koelaria macrantha,* quaking grass *Briza media* and glaucous sedge *Carex flacca.*

Meadows. The hay meadow (G05) has perhaps been one of the most challenging habitats to create because of the soil's fertility and the lawn turf applied to the area in 1995. In retrospect a more natural meadow could have been created by first stripping this turf. The aim has been to create a meadow based loosely on NVC community MG5 by adding plants and seeds to the existing lawn sward. It had reached a total of 75 species in 2002 compared to 50 in 1998. Whilst several new species have been planted since 1998, others have arrived on their own, for example lady's bedstraw, upright hedge-parsley *Torilis japonica,* common hemp-nettle *Galeopsis tetrahit* and hairy tare *Vicia hirsuta,* the last two species being new additions to the garden.

Meadow crane's-bill *Geranium pratense,* betony *Stachys betonica* and yarrow, all of which were introduced as pot plants in 1995, still thrive, whilst oxeye daisy has declined in abundance (Table 3). Species introduced since 1998, including common bird's-foot trefoil, meadow vetchling *Lathyrus pratensis,* meadow buttercup *Ranunculus acris,* bulbous buttercup *R. bulbosus.* and sweet vernal-grass *Anthoxanthum odoratum* have increased. Less acceptable additions include common couch *Elytrigia repens* and sterile brome *Anisantha sterilis,* the latter usually more common on open disturbed soils. Interestingly the introduction of red fescue *Festuca rubra* has made little impact in this meadow compared to meadow G02 where it has out-competed cock's-foot *Dactylis glomerata* as intended.

TABLE 3. Dominant and abundant plant species in Meadow, 1998 and 2002.

1998 Dominant species > 100 plants	**1998** Abundant species 51–100 plants	**2002** Dominant species > 100 plants	**2002** Abundant species 51–100 plants
Achillea millefolium	*Epilobium* sp.	*Agrostis stolonifera*	*Achillea millefolium*
Agrostis capillaris		*Anisantha sterilis*	*Lotus corniculatus*
Agrostis stolonifera		*Geranium pratense*	*Plantago lanceolata*
Conyza sumatrensis		*Holcus lanatus*	*Trifolium repens*
Geranium pratense		*Lolium perenne*	
Leucanthemum vulgare		*Poa trivialis*	
Lolium perenne		*Stachys officinalis*	
Poa trivialis		*Trifolium pratense*	
Senecio jacobaea			
Trifolium repens			

The performance of the different plant species introduced since 1998 will be detailed elsewhere.

Meadow area G02, sown in 1994/5 as two distinct areas, has been treated as one since 1998. A dense area of cock's-foot has been successfully reduced and replaced by additional red fescue and common knapweed *Centaurea nigra.* However, the dominance of ribwort plantain *Plantago lanceolata* has not been reduced. An unwelcome invasive species is stone parsley, which is proving difficult to restrain in spite of intensive weeding and resowing. Great burnet *Sanguisorba officinalis,* is conspicuous in this small area. The one introduced plant of fennel remains. Hog's fennel *Peucedanum officinale* introduced in 1995, is a nationally scarce species along the Essex and Kent coasts with exacting requirements, but is quite at home here.

The creation of an orchard area G03 in 2000 has been described above. It has a total of fifty species. The dominant grasses are meadow foxtail *Alopecurus pratensis,* creeping bent *Agrostis stolonifera,* cock's-foot, red fescue and barren brome. Introduced broad-leaved species include meadow buttercup, cowslip and meadow sweet *Filipendula ulmaria.* Bladder campion *Silene vulgaris,* planted in G02, G03 and G04 in 1995, remains in all three areas.

The small grassland area G04 on the edge of the pond contains a mix of wetland and meadow species including red fescue, tufted hair-grass *Deschampsia cespitosa* and meadowsweet, with wild strawberry *Fragaria vesca* and harebell *Campanula rotundifolia* bordering the dry path edges.

Heathland. The main area of dry heathland LH01, planted in April 1998, still retains heather *Calluna vulgaris* as the dominant species with bell heather *Erica cinerea* and dwarf gorse *Ulex minor.* While the heathers have become somewhat leggy due to insufficient mowing or cutting, the plants are suffering from heavy shade cast by the London planes during summer and thick leaf fall during winter. Although efforts are made to protect the heath in winter, this is not the ideal situation for lowland heath. Dwarf gorse, however, which started off less promisingly, has benefited from the high nitrogen levels emitted by the nearby traffic.

Western gorse *Ulex gallii* and gorse *Ulex europaeus,* which line the lane from Queen's Gate along the edge of the heathland, have provided nesting sites for long-tailed tits. Bristle bent *Agrostis curtisii,* introduced as seed in 1999 and now self-seeding, is an attractive plant in early summer before the heather comes into flower. Foxglove and broad buckler-fern have self-sown in the gaps created by failing heather. Other less welcome self-seeders, including Yorkshire fog and Guernsey fleabane *Conyza sumatrensis,* are frequently removed. Several other species have self-sown around the edges of the heathland and woodland.

The wet heath LH03 was formed between the dry heath and the pond A08 in spring 1999. This community included common cotton grass *Eriophorum angustifolium,* bog asphodel *Narthecium ossifragum,* purple moor-grass *Molinia caerulea* and bog myrtle *Myrica gale.* The small turfs containing the plants were planted in a butyl-lined bed, which is kept damp by topping up with rainwater. The community now comprises the last two named species only. The other two, and the sphagnum moss *Sphagnum papillosum,* disappeared after one year probably due to shading by the London planes. Summer lady's-tresses *Spiranthes aestivalis* and common heath orchid *Dactylorhiza maculata* were introduced in March 2003.

Wetland

Ponds. The three ponds are the focus of the garden and support a diverse flora. Although the two smaller ponds, A01 and A08, were designed to represent chalk and peat ponds respectively, the water system for all three ponds is linked. The presence of blanket weed, reported in 1998, had been reduced by 1999. Water fern *Azolla filiculoides* and duckweed *Lemna minor* have since successively invaded the main and upper ponds, though the water fern has been successfully removed. In April 2002 the blanket weed returned, possibly due to the unseasonally hot weather in April before the season's growth of rigid hornwort *Ceratophyllum demersum* and other submerged plants. It has also been necessary to control some submerged species.

Many pond communities are species-poor with a single strong dominant. In the main pond for example, the dominance of Canadian waterweed *Elodea canadensis,* introduced in 1995, has been taken over by rigid hornwort, introduced with spiked water milfoil *Myriophyllum spicatum* in 2000. This may be partly due to the suppression of Canadian waterweed by duckweed (Grime et al. 1990) during 2000. Hornwort was thinned during winter 2001/2. Curled pondweed *Potamogeton crispus,* introduced to the top pond (A08) in 1995, is currently the dominant aquatic plant in the main pond. The differences between the aquatic plant communities in the three ponds is summarized in Table 4.

The pond margins are more species-rich. Emergent plants around the chalk and main ponds are similar in composition and include water mint *Mentha*

aquatica, marsh marigold *Caltha palustris*, yellow iris *Iris pseudacorus* and galingale *Cyperus longus*, while the upper pond, representing a more acidic habitat, has a margin of water horsetail *Equisetum fluviatile*, soft and hard rush *Juncus effusus* and *J. inflexus* and some bogbean *Menyanthes trifoliata*. Although marginal plants are also periodically thinned, their cover provides seclusion for moorhens. The plant community on the recently constructed island is also developing.

TABLE 4. Aquatic plants in three ponds, 2002.

	Chalk pond A01	**Main pond A03**	**Top pond A08**
Floating leaved plants	*Lemna gibba* *Lemna trisulca* *Nuphar lutea*	*Lemna minor* *Lemna trisulca* *Nymphaea alba*	*Lemna minor* *Lemna minuta* *Lemna trisulca*
Submerged plants	*Callitriche stagnalis* *Myriophyllum spicatum* *Potamogeton crispus*	*Ceratophyllum demersum* *Elodea canadensis* *Hippuris vulgaris* *Potamogeton crispus*	*Potamogeton crispus* *Elodea canadensis*

Reedbed. The reedbed is a pure stand of common reed *Phragmites australis*. The three beds were cut in rotation in 1998, 1999 and 2000, and then left uncut for two years. The rotation began again in 2003. The reeds that were planted in 1996 are now over two metres tall. Other species that appear in the reedbed are removed periodically.

Fen. The main fen areas F01 and F02 contain 53 species, as recorded in early 2003.

Several of the earlier introductions (in 1998) failed to survive beyond their first year of flowering, including marsh thistle *Cirsium palustre* and marsh pennywort *Hydrocotyle vulgaris*. Similarly, some species introduced from Hickling Broad in 2000 were not found during the following year. It is likely that these have been shaded out. Nevertheless, there remain a variety of fen plants for visitors to view on either side of the board walk (F01 and F02). These include great fen sedge *Cladium mariscus*, common reed, tufted sedge *Carex elata*, marsh fern *Thelypteris palustris*, meadowsweet and yellow loosestrife *Lysimachia vulgaris*. Late spring colour is provided by ragged robin, cuckooflower *Cardamine pratensis* and marsh marigold *Caltha palustris*.

Urban habitats

The urban habitat (U01) has increased in area since 1998 and includes a recently planted hedge between the yew hedge and buddleia. With the increase in area there is a greater number of species: 62 compared to 29 in the previous survey. Notable self-sown arrivals — especially on the bare soil created on the new mound — include the cultivated species, love-in-a-mist *Nigella damascena* and Adria bellflower *Campanula ortenschlagiana*.

Problems of edge influence. Whilst most of the habitats have retained their identity, compared to four years ago, there are many more species that have spread across habitats and any relaxation of management will reduce the number and character of habitats. During the first three years in the garden, weeding focused on the short-term opportunists such as groundsel *Senecio vulgaris* and redshank *Polygonum aviculare*. Removing misplaced or invasive plants hidden in thick vegetation is now more of a challenge. Stone parsley has been mentioned above. Common angelica *Angelica sylvestris* and common nettle *Urtica dioica* have also spread. The most commonly occurring species and the number of plots in which they occur are listed in Table 5.

TABLE 5. Species occurring in 15 or more plots within the garden.

Species	Common name	1998	2002
Angelica sylvestris	wild angelica	8	20
Achillea millefolium	yarrow	22	22
Brachypodium sylvaticum	false brome	8	20
Corylus avellana	hazel	13	17
Deschampsia cespitosa	tufted hair-grass	10	17
Dipsacus fullonum	wild teasel	22	20
Epilobium hirsutum	great willowherb	16	22
Filipendula ulmaria	meadowsweet	10	17
Galium mollugo	hedge bedstraw	20	22
Geranium robertianum	herb Robert	6	21
Geum urbanum	wood avens	8	23
Holcus lanatus	Yorkshire fog	23	18
Plantago lanceolata	ribwort plantain	26	24
Prunella vulgaris	selfheal	19	21
Ranunculus acris	meadow buttercup	10	17
Ranunculus repens	creeping buttercup	21	18
Rubus fruticosus agg.	blackberry/bramble	8	16
Silene dioica	red campion	14	20
Taraxacum officinale agg.	dandelion	17	16
Urtica dioica	common nettle	23	22

Many of the recently colonising animals and insects have benefited from the increasing maturity of the garden: trees, shrubs and pond margins provide increased cover for birds and the abundance of food plants for insects is growing. However, the arrival of other anticipated species has not materialised because habitat management has stemmed succession.

Bryophytes (Len Ellis, Dept. of Botany, NHM)

For a small green area in London the garden supports a relatively high diversity of bryophytes. In damp periods swathes of moss cover stony paths, soil, rocks, and to a lesser extent tree trunks. Since monitoring began in 1995 some forty-nine moss and seven liverwort taxa have been recorded. While many of these have persisted throughout the garden's history, some have vanished and others appear to have arrived only recently. The ever-present elements of the bryoflora include species generally common in gardens and woodland in south-east England such as *Eurhynchium praelongum*, *Brachythecium rutabulum* and *Bryum capillare*. These are widespread and abundant here occurring in most of the different habitats. Some other common but less widespread mosses here include *Amblystegium serpens* (often found fruiting in spring), *Tortula muralis* on basic rocks and walls, *Barbula unguiculata*, *B. convoluta* and *Fissidens taxifolius* on exposed soil, and *Calliergon cuspidatum* in grassy places. *Orthotrichum diaphanum*, very common in south-east England, was absent in the early days of monitoring, and since its arrival in the garden has fluctuated in abundance. In damp periods in spring and early summer it becomes dominant on rock surfaces, but seems to shrivel away in hot, dry periods.

Some common ephemeral taxa, like *Tortula truncata*, that quickly colonize bare, disturbed soil, were recorded in the earlier days, but appear to have vanished as the various habitats have matured.

Among the more interesting taxa here are those incidentally brought in with imported rocks, logs and soil from relatively exotic localities. *Racomitrium aciculare* is a moss that grows on acidic rock by water and is relatively rare in south-east England. It is presently thriving on gabbro and augen gneiss in the pond bank area (G04). Originally, this moss appears to have been under some

stress, as its leaves were slightly aberrant with a strangely lax cell structure. Despite, occurring near a busy road in the heart of London, it is now thriving and has developed normal leaves. *Schistidium rivulare*, a related moss, not normally occurring in south-east England, was recorded here in March 2002. It had been imported into the pond bank area (G04) on black and white gneiss. Unfortunately, it has since disappeared. Similarly the widely distributed calcicolous liverwort *Leiocolea turbinata* arrived with the turf of the chalk grassland (G01) but it became overgrown by grasses and has not been seen since 1999.

The recent introduction of mossy logs into woodland W09 has added several common woodland species, including the liverwort *Lophocolea bidentata* and the moss *Mnium hornum*. After some months they still appear to be flourishing. Less successful, the liverwort *Marchantia polymorpha*, imported with plants for the meadow (G02), was quickly squeezed out by the grasses.

Mosses deliberately introduced have tended to expire. *Polytrichum formosum* planted in a woodland area (W09) survived for at least a year before disappearing, and *Thuidium tamariscinum* (planted in woodland areas W05, W09) and *Sphagnum papillosum* (planted in lowland heath LH03), have also slowly faded away.

Lichens. Changes in lichen communities between December 2000 and March 2003 (Pat Wolseley and Peter James, Dept. of Botany, NHM)

Despite the diversity of habitats, both in terms of substrate and widely varying light and moisture regimes, few lichen communities are yet established here. Tree bark is still poorly colonized despite the appearance of lichens in the canopy. The *Lecanora conizaeoides* recorded on the lime tree towards the centre of the garden has now almost vanished beneath a haze of green algae. This lichen, formerly common due to the impact of sulphur dioxide on urban habitats prior to the Clean Air Acts, is now disappearing from urban areas following dramatic reductions in SO_2 concentrations. Changes in the species list since December 2000 mainly reflect the rapid loss of species brought in on substrata from other habitats (Table 6).

Ubiquitous lichens now present on all substrates are nitrophytes tolerant of nutrient enrichment and particulates associated with high levels of traffic emissions, the most conspicuous species being the bright yellow easily identifiable *Xanthoria parietina*. Cromwell Road is infamous for its high traffic density and pollution concentrations, and excesses of the objectives for human health for NO_2 (21 ppb annual mean) and particulates occur in all parts of the garden (Cirimele et al. 2002).

The original saxicolous quadrats had all been selected to contain specimens of *Xanthoria parietina*. However, between 2001 and 2003 this species had disappeared or almost gone from five quadrats (Table 6). Both acid and basic rock substrata had been selected, and the most conspicous loss of *Xanthoria* was on acid substrata in exposed sites (e.g. Q5) whereas it was still healthy and growing well on base-rich substrata (e.g. Q3, Q6). However, in some sites the loss was associated with other factors; in Q7 increased shading due to rapid growth of shrubs around the boulder gave bryophytes and grazing molluscs an advantage, and in Q 1 and Q 2 the loss was associated with heavy use by an increasing population of waterfowl. There was also a considerable increase in other crustose nitrophytes such as the dirty-yellow *Caloplaca crenulatella* (now regularly recorded in urban areas), *Lecanora muralis, Lecidella stigmatea* and a foliose species of *Physcia*. Recording of levels of nitrous oxides ppb. across the transect from Cromwell Road showed a rapid fall-off in levels of all oxides of nitrogen from the road to 120 m into the garden (Cirimele et al. 2002). Rather surprisingly the results of chlorophyll fluorescence of lichens transplanted from the clean air site in Somerset showed that thalli of *Parmelia sulcata* continued to be physiologically active and alive after four months exposed to the traffic emissions from Cromwell Road. An assessment of the frequency of different size classes of *Parmelia sulcata, Xanthoria parietina, Evernia prunastri* and *Ramalina farinacea* showed that mature thalli were the most vulnerable, and that

maximum losses occurred in the most sheltered part of the garden and not in the sites closest to Cromwell Road. However it is difficult to compare loss by thallus size as loss of larger thalli often occurs by a process of fragmentation with the older parts dropping off first and the younger parts remaining as small thalli. This feature is also observed in *Xanthoria parietina* on saxicolous substrates where the oldest parts of the thallus have become discoloured then lost leaving younger lobes at the margins (Figure 7). This feature is characteristic of lichens in stressed or polluted environments. However, several species have shown a remarkable rate of colonization with many young thalli established on suitable substrata such as *Lecidella stigmatea* and *Lecanora muralis* which are now becoming frequent on calcareous substrates. This agrees with earlier observations in urban areas by Gilbert (1990). Other urban colonizers mentioned by Gilbert include *Steinia geophana* and *Thelidium minutulum* found on chalk pebbles in G01.

TABLE 6. Changes in lichen species since 2002.

Q no.	Location	Lichens recorded 27.iii.2003	Changes
1 A10 above pond	Limestone exposed	*Lecanora albescens*	Heavy manuring from duck faeces, few lichens remaining
2 A10	Limestone exposed	*Caloplaca crenulatella* *Lecanora muralis* *Phaeophyscia orbicularis* *Xanthoria parietina*	Rapid growth of *Xanthoria* in first 6 months followed by fragmenation and loss. Site much used by waterbirds
3 P05 wall top	Limestone exposed	*Caloplaca holocarpa* *Lecanora albescens* *L. dispersa* *Lecidella stigmatea* *Xanthoria parietina*	*Xanthoria* healthy and growing radially
4 P05 wall top	Limestone formerly shaded	*Caloplaca crenulatella* *Caloplaca citrina* *Lecanora dispersa*	*Xanthoria* lost by 16.viii.2002 due to dense shading from adjacent undergrowth
5 F03 Boulder	Schist Exposed	*Candellaria aurella* *Lecanora dispersa* *L.muralis* *Lecania erysibe?*	*Xanthoria* growing radially until vi.2001, lost by 16.viii.2002
6 DF Boulder	Purbeck limestone exposed	*Lecanora albescens* *Lecanora dispersa* *Xanthoria parietina*	*Xanthoria* healthy and growing well
7 W08 Boulder	Gneiss shaded by shrubs	*Lecanora muralis* *Lecidella stigmatea* *Xanthoria parietina*	Major increase in bryophyte cover and *Xanthoria* almost lost between 2001 and 2002
8 LH01 Brick edge	Track edge used by traffic	*Caloplaca crenulatella* *Lecanora muralis* *Xanthoria parietina*	*Xanthoria* split into 2 thalli, both showing radial growth.
9 S03 Boulder	Red sandstone exposed	*Lecanora muralis* *Lecidella stigmatea* *Phaeophyscia orbicularis* *Physcia adscendens/tenella* (young) *Xanthoria parietina*	*Xanthoria* increased radially, centre mature parts lost by 16.viii.2002. Many young thalli of *Xanthoria, Physcia,* and *Lecanora muralis.*
10 G01 Boulder	Chalk and flint exposed	*Xanthoria parietina* *Caloplaca citrina* *Lecidella stigmatea* *Physcia adscendens* *Rinodina gennarii*	*Xanthoria* still present, very little growth. *Lecidella* abundant and spreading, others present.

The frequent occurrence of nitrophytes on all saxicolous substrates is a feature of this garden, but the distribution of each species varies with both rock type and the local conditions of shade and exposure. The exposed saxicolous substrates with a higher pH, such as chalk and limestone, have healthy nitrophyte communities in undisturbed sites whereas the boulders of granite and schist have lost *Xanthoria* species since December 2000. This suggests that there is a buffering effect from basic substrata on lichen communities. Seaward (1976) has observed that *Lecanora muralis* was restricted to calcareous substrates in urban areas while in rural areas it was found on acid substrates.

Although all introduced species from acid habitats have disappeared rather rapidly from the garden, the species on transplanted twigs did not deteriorate as rapidly as expected. This may in part be due to weather conditions affecting deposition during the period of exposure. However, the greatest changes in *Parmelia sulcata* were observed in the site furthest from the road. This was rather heavily shaded whereas in the more exposed sites close to the road there was little effect during the three-month winter period indicating that shading has a significant effect, especially on photophilous species. Loss of *Xanthoria* was also apparent on boulders that had become shaded by shrub or ground cover (Q7), where there had been a 50 per cent increase in bryophyte cover.

A recent feature of urban sites has been the rapid invasion of nitrophilous lichen species following the Clean Air Acts and decreasing levels of SO_2. This is most conspicuous on trunks and branches of younger trees in many London parks, where, during an ongoing survey, species are now occurring that have never previously been recorded for central London (James et al. 2002, Davies et al. 2002). This newly available habitat is not affected by past pollution and is probably where we should expect the biggest change in the lichen communities, and where we should be on the lookout for new species on fallen twigs, or on branches when pruning takes place.

Conclusions

Trees in urban areas are now developing a lichen flora characterized by increasing numbers of nitrophyte and particle-tolerant species, including those not formerly recorded in urban areas. Monitoring of permanent quadrats has charted both growth and loss of individual thalli and colonization by invasive species that are both nitrophytes and urban species. Changes in the cover of lichens appeared to be more influenced by substrate composition and microclimatic conditions in the garden than by recorded pollution levels. If, as predicted, air quality continues to improve given recent advances in 'clean vehicle technologies', we may expect an increase in lichen diversity here.

Microfungi (J. E. M. Mordue, 77 Kings Stone Avenue, Steyning, West Sussex)

Microfungi (Micromycetes) are fungi having small (microscopic) sporocarps. Many are members of the phylum Ascomycota (Ascomycetes) which includes among others the Erysiphales (powdery mildews), and Discomycetes (smaller cup fungi), the conidial fungi Coelomycetes and Hyphomycetes and some Basidiomycota (Basidiomycetes) of which the most significant microfungi are the rusts (Uredinales) and smuts (Ustilaginales). In 1997, fourteen specimens of Microfungi were identified to species level, but by October 2002 this had increased to ninety-seven. This is still an extremely small proportion of the number that could be expected in such a diverse garden.

Most microfungi likely to be recorded here are to a greater or lesser degree host specific, either as pathogens or as endophytes or saprophytes. There is only one general reference available, certainly to field mycologists (Ellis and Ellis 1997), and the species lists given here follow the groupings shown in this work. Because they are small and host specific, the search for microfungi commonly takes the form first find the host, then examine it for the presence of the fungus.

Usually, host genus is more significant than species (identification of the host to species level is occasionally a problem because diseased hosts can be abnormal in growth and may not flower). Many of the hosts are herbaceous plants that occur widely in the garden. A host such as *Holcus* is probably present in almost every plot; where *Holcus* is, *Puccinia coronata* probably is too, at least at some stage during the growing season. Similarly *Phyllactinia guttata* on *Betula* and *Corylus* and *Sawadaea bicornis* on *Acer campestre* are probably present wherever the hosts grow, but collecting has so far been insufficient to demonstrate this.

Rust fungi: Uredinales

Seventeen rust fungi have now been recorded. Of these, eleven species are heteroecious, requiring two unrelated hosts to complete their life cycles. As yet, infection on the alternate host has not been recorded for any of them, nor have all spore states been seen for autoecious species. This may be because of the seasonal character of the life cycle (no recording visits have been made in spring), but in this relatively protected, southern garden, many rusts probably perennate in the summer (urediniospore) state without a requirement for host alternation.

Several of the very common rust fungi whose absence from 1997 records was noted are now present. The first record of a *Melampsora*, *M. epitea*, on willows dates from 1999 and this species is now widespread on *Salix caprea* and *S. cinerea*. The common willowherb rust *Pucciniastrum epilobii* was first recorded in 2001 and the other common rust on this host, *Puccinia pulverulenta*, in 1999. Both were recorded in 2002. One blackberry rust, *Phragmidium violaceum*, appeared with poor sporulation in 1999 and has not been seen since, while *Phragmidium bulbosum* on this host appeared in 2000 and was collected in 2002 with excellent sporulation. This is possibly an instance of a minor infection dying out followed by reinfection by a different species.

Smut fungi: Ustilaginales

The first smut fungus, *Urocystis ranunculi* on *Ranunculus*, was recorded in 2000. This, as a 'leaf smut', is likely to be present over a longer part of the active growth period of its host than are many 'flower' smuts, but it has not been recorded again.

Cup fungi: Discomycetes

Discomycete recording, with eight species (and one *Taphrina*) has hardly started. The discomycetes include many plurivorous wood and bark fungi and leaf litter fungi and some sporulate in winter and spring, hence they have not yet been much investigated.

Other Ascomycetes

These are taxonomically a very diverse group. With fifty-six species, they have contributed more records than any other fungus group, although the many species that sporulate on dead twigs and branches, wood and bark, and in winter or early spring, have, like the discomycetes, been neglected. A preponderance of the records is of powdery mildews (Erysiphales), with thirty-seven species and a number of additional conidial states (*Oidium* spp.) observed. A particularly interesting record is *Uncinula flexuosa* on horse chestnut *Aesculus hippocastanum*. This species was originally described from North America, on *A. hippocastanum*, *A. carnea* and several other *Aesculus* species. The first European record was made in Switzerland, on street trees of *A. carnea*, in September 2000, then on *A. hippocastanum* in 2001. This discovery stimulated search in England and there are now records for 2001 in the Royal Botanic Gardens, Kew, and in Esher, Surrey (Ing and Spooner 2002). *Uncinula flexuosa* is thought to be spreading rapidly, and is presumably tolerant of urban pollution.

An Ascomycete not normally considered very tolerant of urban pollution is *Diplocarpon rosae*, the causal organism of rose black spot disease. This has been recorded twice on *Rosa* sp. in hedgerow (H02) and woodland (W08), both late season records (late October, November) suggestive of relatively slow annual disease development.

Hyphomycetes and Coelomycetes

Both groups are poorly represented in records to date. *Ramularia*, with four species, all leaf spot pathogens of herbaceous dicotyledons, is the only Hyphomycete genus with more than one species; the other three genera recorded have one species each and are not host specific. The Coelomycetes include two leaf spot pathogens, *Phoma hedericola* and *Septeria leucanthemi*, one species regarded as plurivorous on dead stems and petioles (*Colletotrichum dematium*), *Cytospora platani* on *Platanus*, commonly on dead attached twigs, *Ceuthospora phacidioides* on fallen dead *Ilex* leaves and *Ampelomyces quisqualis* on powdery mildews. There should be many more members of these groups, both as pathogens and saprophytes on dead herbaceous stems, leaf litter, wood, bark and similar substrata.

Parasites on Microfungi

The important plant pathogens, rust fungi and powdery mildews, are accompanied in the garden by some of their natural enemies. The Ascomycete *Eudarluca caricis* (commonly seen in its Coelomycete state, *Sphaerellopsis filum*) is parasitic in sori of rust fungi. It is particularly common on *Puccinia* species (on *P. punctata* here) but is also found on many other rust genera. The Coelomycete *Ampelomyces quisqualis* parasitises powdery mildews. Also present on rusts and powdery mildews, feeding on spores and hyphae, are *Mycodiplosis* (Diptera) larvae.

It is tempting to speculate how far the species recorded have been imported with their hosts and how far their appearance results from infection from other sources. The steadily increasing number of species hints that colonization is occurring after the introduction of the hosts but there also may be an element of latent infection. A few species have been recorded every year, e.g. *Phyllactinia guttata* and *Puccinia coronata*, others only once e.g. *Puccinia variabilis*, *Septoria leucanthemi*. The intensity of collecting has been too low to indicate whether absence of a record indicates absence of the fungus or whether it merely indicates poor sporulation or failure to observe sporulation during the annual visit.

Fungi (Brian Spooner, Dept. of Mycology, Royal Botanic Gardens, Kew)

The fungi of the garden have so far received comparatively little study and remain considerably under-recorded. In addition to the work on microfungi by Elizabeth Mordue, there have been just four visits since the previous report (Honey et al. 1998). However, these have provided some interesting results, increasing the total species list from thirty-three to over 160. These visits, in October 2000, November 2001, March 2002 and December 2002, were undertaken as time allowed and have mostly not been at the most productive times for fungal fruiting. They have also been comparatively brief and it is certain that many more fungi remain to be discovered. Indeed, in a small site with a plant list of around 360 species, it might be expected that well over 2,000 species of fungi would be present.

Fungi are an integral and essential part of any ecosystem and have an immensely important role to play, as true here as at any other site. They are the main agents responsible for recycling of nutrients through the decay of organic matter, but also include many species which live in intimate symbiotic association with plant and animal partners. The latter include mycorrhizal species, which are essential to plant health and on which almost all plant species

are now known to depend. Plant pathogens are also common, linked intimately to the life cycles of their hosts and fulfilling another essential role which, at least in a natural environment, is integral to the ecology and no cause for concern. Nevertheless, there are many aspects of fungal ecology and distribution which are still little known, and recording work is an important component in appreciating and understanding the role of fungi and their interaction with other organisms.

No systematic investigation of the fungi of the garden has yet been possible, and many potential niches remain unsurveyed. As might be expected, many of the species recorded hitherto are common and widespread, though some scarcer and less-known species have been found. Some are of additional interest in having been probably introduced with their host plants and substrates, for example, the rust *Puccinia magnusiana*.. This species forms small sori on leaves of *Phragmites* and is very scarce in south-east England. It is much more frequent in parts of East Anglia, the area from which the *Phragmites* in the garden was obtained. However, other microfungi associated with the *Phragmites* are unlikely to have been introduced. *Phaeosphaeria eustoma*, for example, collected on decaying leaves, is a common species on a range of grasses and some other monocot hosts.

Larger fungi

Less than forty of the species so far recorded might be considered to fall under this heading, a convenient though ill-defined term which refers merely to species with fruitbodies large enough to handle. There are likely to be many more species present, and further collecting during autumn should be productive. Most of those recorded are Basidiomycetes, the huge group to which most of the larger fungi belong, and include several species of agarics and bracket fungi. Amongst these are some common and widespread species such as *Coprinus atramentarius* (common ink-cap) and *C. comatus* (shaggy ink-cap), as well as other agarics including *Hypholoma fasciculare* (sulphur tuft), on stumps and the sought-after and edible *Lepista nuda* (wood blewit). Various common bracket fungi such as *Trametes versicolor* (the 'many-zoned polypore') and *Stereum hirsutum* are also usually in evidence, as are the common jelly fungi *Auricularia auricula-judae* (Jew's ear) and *Dacrymyces stillatus* ('jelly spot') on rotten wood. However, Ascomycetes, another huge group the majority of which are generally considered as microfungi, are also represented amongst the larger fungi. *Daldinia concentrica* ('cramp balls'), found in the garden on its commonest substrate, a stump of ash, is a good example, as is its close relative *Xylaria hypoxylon* candle-snuff, which grows on various kinds of dead wood.

Species of interest amongst the larger fungi include the agarics *Conocybe striaepes*, an uncommon yellowish-brown species of woodlands and parks, and *Lepiota subincarnata*, a widespread toadstool which seems to be characteristic of ruderal habitats. *Marasmius rotula*, often known as the 'little wheel toadstool', a common species on dead twigs and roots, was found here on a most unusual substrate, dead wood of *Syringa*. Other species of note include the corticioid Basidiomycetes *Sistotrema oblongisporum* and *Trechispora nivea*, both of which occur on various kinds of rotten wood but are seldom recorded. Another, found on the underside of an old *Populus* log, is *Mycoacia fuscoatra*, which is fairly common but infrequently collected. This has a hymenium of fine, yellowish teeth or spines and is similar to the more common *M. uda* but blackens with age.

Other fungi

Many of the microfungi have been discussed above. Additional to these might be mentioned *Erynia neoaphidis*, the only entomogenous fungus recorded so far. Species of this and related genera are important insect pathogens, most of them strictly host limited, and some with potential for biocontrol of pest species. *Erynia neoaphidis*, found here on an undetermined aphid on *Euonymus* leaves, is seldom recorded though potentially infects a wide range of aphids.

Slime moulds (Myxomycetes), although not true fungi, are a usual part of mycological surveys but require further investigation here. Only two species are recorded so far, the common *Leocarpus fragilis* and *Trichia varia*, but many others will be present.

Two other fungi of particular interest are the ascomycete *Cryptosporella platanigera*, and the leaf parasite *Cercospora malvarum*. The first occurs on dead branches of London plane, usually developing high in the tree, and best looked for on fallen branches. It has tiny, clustered black fruitbodies, which develop under the bark. In view of the prevalence of its host tree in London this may be a frequent species but it is little known and seldom recorded. It was described from Leicestershire in 1851 and this seems to be only the second collection made since then, the first being from Holland Park in 1995. *Cercospora malvarum* develops in leaf spots on species of *Malva*, in this case *M. moschata* (musk mallow), and forms long, multiseptate conidia. It has apparently not been previously recorded from Britain, and awaits formally reporting as a new British record.

Plant galls

Plant galls remain under-recorded in the garden. The following eleven galls were collected by J. Berry in October 2002, and identified by K. Hill. Nomenclature follows Redfern and Shirley (2002).

On *Acer campestre: Aceria aceriscampestris, Aceria eriobius*

On *Alnus glutinosa: Acalitus brevitarsus, Eriophyes laevis*

On *Crataegus* sp.: *Aceria crataegi*

On *Fagus sylvatica: Hartigiola annulipes*

On *Populus* sp.: *Pemphigus spyrothecae*

On *Quercus* sp.: *Andricus lignicola* (asexual generation), *Cynips divisa* (sexual generation), *Neuroterus quercusbaccarum* (asexual generation)

On *Salix* sp.: *Pontania proxima*

FAUNA

Invertebrates

Aquatic macroinvertebrates (Steve Brooks, Dept. of Entomology, NHM)

Following initial colonization of the pond, the last five years, since 1997, have seen a period of consolidation. There appears to have been little change in the composition of the macroinvertebrate fauna during this period. We anticipated that there would be a shift in the species assemblages in response to succession in the plant communities and with colonization of the ponds by new macroinvertebrate taxa and that species typical of open water biotopes would be replaced by those more at home in denser vegetation. However, ongoing management of the aquatic plants has meant that for most of the time the ponds have remained relatively open. In addition, excessive growth of blanketing filamentous algae has suppressed the growth of macrophytes. As a result, there are still substantial populations of insects typical of open water such as the waterboatman *Hesperocorixa linnaei*, the backswimmer *Notonecta glauca*, and *Plea minutissima* and larvae of the phantom midge *Chaoborus crystalinus*. One major group that is still absent from the pond is the caddisflies (Trichoptera). Although adults are frequently found in the light traps, their aquatic larvae have not yet been caught.

The three ponds were originally designed to reflect three different biotopes: a high pH pond receiving run-off from the chalk mound, a shady pond, and a large pond open to the sun. There was a possibility that each would support a different fauna and flora. However, all currently support a similar assemblage of macroinvertebrate species.

Large populations of two species of water louse, *Asellus aquaticus* and *A. meridionalis,* and the shrimp *Crangonyx pseudogracilis* are still present. Two species of leech, *Erpobdella testacea* and *E. octoculata,* have been recorded since 2000 but there have been no recent records of *Helobdella stagnalis,* which was present in 1996. Both species of flatworm, *Dugesia lugubris* and *Polycelis nigra,* that were recorded in the earlier survey are still abundant.

Perhaps the biggest change in the fauna has occurred in the Mollusca. Of the six species recorded in the first survey only *Bithynia tentaculata, Lymnaea stagnalis* and *Planorbarius corneus* have been recorded since 2000. *Lymnaea peregra, Physa fontinalis* and *P. carinatus* all seem to have disappeared. However, several previously unrecorded species, *Gyraulus albus, Planorbis planorbis, Valvata cristata* and *Anisus vortex,* are now present.

No more larvae of the mayfly *Caenis* sp. have been found in recent years, but larvae of the pond olive mayfly *Cloeon dipterum* are still abundant in all three ponds as are larvae of the azure damselfly *Coenagrion puella.* Early instar damselfly larvae tentatively identified as *Ischnura elegans* were also present. However, young larvae of this species are difficult to distinguish from those of the common blue damselfly *Enallagma cyathigerum,* so breeding of the former species cannot be confirmed, although adults are frequently present. In addition to adults of the three damselflies mentioned above, adult dragonflies of the species *Anax imperator, Aeshna cyanea* and *Sympetrum striolatum* are also frequent and are almost certainly breeding. Aquatic Diptera are represented by several families, including Chironomidae (non-biting midges), Culicidae (mosquitoes), Chaoboridae (phantom midges), Dixidae (meniscus midges) and Stratiomyidae (soldierflies).

Coleoptera (Max Barclay, Dept. of Entomology, NHM)

Over 350 species of beetle have been recorded since the garden opened and a fuller account of these, in conjunction with records from other London parks, is in preparation by Peter Hammond.

Pitfall-trap monitoring in August 2002 produced a small list of generally abundant species, including the largest native rove beetle, the predatory devil's coach horse *Staphylinus olens.* The most unusual species recorded in these traps was the fairly local, bright green, seed-eating ground beetle *Harpalus rubripes,* which is not uncommon on rough grassland in the London area and has been recorded here before.

Diptera (blowflies) (Zoe Adams, Dept. of Entomology, NHM)

The numbers of flies caught, in a single 24-hour period, ranged from zero during cold winter weather up to 537 on 27 June 2001. The majority came from the blue-bottle genus *Calliphora,* namely *C. vicina* (n=3,676, 82.5% of total catch) and *C. vomitoria* (n=21, 0.4%). In addition smaller numbers of greenbottle flies of the genus *Lucilia* were trapped, *L. illustris* (n=345, 7.7%), *L. caesar* (n=184, 4.1%), *L. ampullacea* (n=182, 4.1%), and the sheep strike fly *L. sericata* (n=49, 1.1%). With the exception of *C. vicina* all of the blowfly species recorded were markedly seasonal, first appearing on the wing during May and disappearing again in late October. *C. vicina* adults were found in the garden throughout the year and were frequently seen sunning themselves on sunny winter days even in low temperatures. With the exception of *L. ampullacea* all these species are considered common.

Calliphora vicina is a common urban species closely associated with man, *C. vomitoria* on the other hand shows no synanthropic tendencies, with a mostly rural distribution and a preference for wooded habitats. The relative abundance of these two species in the garden, is therefore as expected. *Lucilia sericata* is thought to prefer more-open sunny pasture-type habitats and may be present in greater numbers than indicated, since the trap is sited in the shade. *L. caesar, L. illustris* and *L. ampullacea* are thought to prefer more-shaded woodland-type habitats, and

L. caesar combines this with moderate synanthropic tendencies. The relative abundance of *L. ampullacea* is perhaps surprising as this is supposed to be an uncommon woodland species with a patchy distribution. The presence of *L. sericata*, the sheep strike fly, could be a matter of concern for the garden's sheep.

Lepidoptera (Martin Honey, Dept. of Entomology, NHM)

Species new to the garden have been recorded on a regular basis and the number recorded up to the end of 2002 stands at 462, representing 172 additions. The publication of a provisional list of the microlepidoptera of Middlesex (Plant 2002), in which vice-county the garden is situated, has enabled a rough assessment of their local status. For many of the species listed therein, the examples trapped represent the first records for Middlesex. This is not necessarily a true indication of their scarcity as it may also be a result of the lack of continuous monitoring elsewhere. At least one nationally notable species, *Schoenobius gigantella* (Denis & Schiffermüller, 1775), whose larvae live in the stems of common reed, has been recorded on several occasions. Most surprisingly, two species new to Britain have been recorded here. Examples of the first, *Ectoedemia heringella* (Mariani, 1939), a minute leaf-miner on holm oak, were taken as early as 1996 but remained unidentified other than to genus until a colleague, one of the leading European authorities on that particular family (Nepticulidae), visited the Museum in June 2001. Not only was the species new to Britain but it was previously unknown from northern Europe, having a primarily south-eastern distribution in Europe. It has possibly been overlooked until now due, in part, to its small size (which precludes its study and examination by non-specialists) and by the fact that there is another species in Britain that mines holm oak, producing a similar-looking pattern on the leaf surface. As such it may have been previously misidentified. It is certainly breeding in Britain, at least in the London area, as the distinctive mine has been found in several other locations, from which adults have been bred. The second species, *Prays citri* (Millière, 1873), is almost certainly an adventive or accidental introduction (non-breeding). It is a pest of citrus fruit in the Mediterranean region. How it turned up remains a mystery but it was probably from container-grown lemons that have become popular as patio and balcony plants and are even sold by local South Kensington florists. Both of these discoveries will be the subject of separate papers, to be published in one of the entomological journals. Other discoveries have already resulted in published papers.

A specimen of *Argyresthia trifasciata* Staudinger taken on 19 May 1999 turned out to be the second Middlesex record and others have been taken recently. This species, another adventive (on juniper), was discovered new to Britain in Hampstead, London (Middlesex) in June, 1982. No further examples were recorded in Britain up to 1996, despite it being known to have recently colonized the Netherlands (Agassiz 1996: 76) following its accidental introduction there. From 1997 onwards examples were taken in no fewer than fourteen different vice-counties across Britain, from Petts Wood in West Kent to Aberdeen in Scotland (Plant et al. 2000). It now seems to be firmly established in Britain, its larvae feeding primarily on Leyland cypress.

Particularly pleasing, especially for the public appreciation of the garden, is the increase in both the number of day-flying Lepidoptera being seen and the number of species recorded. A small colony of six-spot burnet moths is now established on the chalk mound and no fewer than four species of butterfly have made their first appearance since our previous report — Essex skipper, orange tip, purple hairstreak and common blue. There was also a report of a silver-washed fritillary on 2 July 2000, but as this species is now so scarce in the London area I regard it as an unconfirmed, but intriguing, record. It is interesting to note that the first British specimen was actually recorded by Petiver in 1699 from the Physic Garden in Chelsea and that the species was still present in Middlesex in the 1950s. Nor would it be the first record for the area

around the Museum as a male was seen on waste ground at the rear of the Museum on 11 July 1935 (Classey 1935).

Additions since 1998 are given in the species list in bold along with the date when they were first captured, wherever possible. Those species that are possibly new to Middlesex are preceded by an asterisk (*), those new to Britain by a double asterisk (**). Records based solely on historic specimens from the museum grounds that have been found in the Museum collections are given in square brackets. Some brief comments on the local status of certain new species of macrolepidoptera have been made based on the distribution maps published in Plant (1993).

Arachnida (Paul Hillyard, Dept. of Entomology, NHM)

The garden has a notably richer assortment of spiders than would normally be expected in central London. None of the seventeen species discovered to date is particularly rare but they are nevertheless interesting.

In the main, spiders are generalist predators but they do have habitat preferences, particularly in terms of the substrate. Thus we find that some species occur only in particular parts of the garden. For example, two species of sac spiders (*Clubiona compta* and *C. brevipes*) find suitable conditions and substrates only on the periphery wall and in the woodland (where they live on tree trunks). We also have a crab spider (*Xysticus cristatus*) and a wolf spider (*Pardosa pullata*) which are here confined to the chalk grassland and meadow, as indeed might be expected *outside* a city!

As the garden matures, we hope to discover further species of spiders taking up residence, as they are extremely efficient at colonizing new habitats. They do it by 'ballooning'. Young spiders and tiny species become airborne attached to lines of their own silk. In this way, they are able to travel long distances and, with a great deal of luck, land in a suitable habitat when air conditions no longer keep them airborne. The problem is that countless numbers perish by being dropped in unsuitable places such as the sea!

Rotifera and Crustacea

Rotifera and anomopodan Crustacea (Eric D. Hollowday, 45 Manor Road, Aylesbury, Bucks.)

A total of fifty-six rotifer species has been recorded since the start of the survey, including five species noted on the first list, but not refound since 1997, whereas the number of anomopodan Crustacea (waterflea) species to date is just eleven.

The origin of these populations is of some interest. As the ponds were originally filled from boreholes, the introduction of either rotifers or waterfleas from this source may be discounted. However, the early introduction of aquatic macrophytes would certainly have led to a 'ready-made' population of both groups, comprising largely (but not necessarily entirely) littoral and benthic (weed-haunting and bottom-dwelling) species. Even planktonic (open or weed-free water dwelling) species may be introduced with aquatic plants, as they occur naturally in the close proximity to marginal weed belts and individuals may become entangled with the vegetation.

Waterfleas first appeared here in pools of rainwater in the newly lined ponds even before the original filling in 1994, perhaps carried in by visiting mallard (Honey et al. 1998). However, as in the case of rotifer 'resting' eggs, the resting eggs of waterfleas may be carried in on the wind, having previously dried out in the shallows of their former habitat.

Of the twenty-two species of rotifer recorded in 1996–7, fifteen were typical weed-haunting species and of the thirty-four additional species recorded in 1997–2002, no less than thirty were of the same category. This tends to suggest that many of the animals arrived with the submerged macrophytes. However, the overwhelming littoral flavour of the rotifer fauna may also reflect the nature

of the ponds themselves (i.e. shallow and weedy with comparatively small weed-free zones). Such conditions do not favour the establishment of the more specialized planktonic species. None the less, none of the latter group has been found to date, except two which occurred briefly (*Keratella cochlearis* in December 1996 and *K. quadrata* in April 1997). The closely related *K. brevispina*, typical of the plankton of small ponds, has flourished almost continuously since 1997. *K. quadrata* f. *dispersa* has been found only once and not since 1999.

The resting eggs of both rotifers and waterfleas are known to remain viable for long periods when dry, for example De Ridder et al. (1988) report rotifers reviving after eight years from dried African mud stored in the laboratory. However, eggs which remain immersed after laying would doubtless hatch much sooner. So it may be reasonable to assume that any such eggs which came in with the first aquatic plants have now hatched, and at least some of the 'newcomers' recorded from 1997 to 2002 may have arrived by more 'natural' means, e.g. as resting eggs attached to the feet and plumage of birds, attached to flying aquatic insects, or blown in on air currents.

Similar considerations must also apply to establishment of the waterflea population. It is however, rather surprising that more species of the family Chydoridae, all weed and bottom-dwelling organisms, were apparently not brought in with the submerged macrophytes. Apart from the ubiquitous *Chydorus sphaericus*, possibly our commonest waterflea, only two other chydorids have so far appeared, one of which *Alona quadrangula*, has only been found once in November 1996.

Also rather surprising, apart from a solitary record of *Daphnia pulex* in November 1997, is the apparent absence of the three members of this genus commonly found in ponds of this size and character, i.e. *D. pulex, D. obtusa* and *D. magna*. Presumably, with the possible exception of *D. pulex,* none of these was introduced with the initial collection of water plants. On the other hand, *D. longispina* is well established in all three ponds. The truly planktonic *Bosmina longirostris*, common in much larger ponds, lakes and reservoirs etc., flourished in quite large numbers, almost exclusively in the main and upper ponds from 1996–7, but has not been seen since.

Isopoda and Amphipoda (Miranda Lowe, Dept. of Zoology, NHM)

The garden has an abundance of *Oniscus asellus* common shiny woodlouse, *Porcellio scaber* common rough woodlouse, *Armadillidium vulgare* common pill woodlouse and *Trichoniscus pusillus* common pygmy woodlouse. These species are widespread throughout the south of England and form part of what is known as the 'famous five' of the isopod world (Hopkin 1991).

Interestingly, an amphipod called *Arcitalitrus dorrieni,* a land hopper, which is originally native to Australia, has been found in similar habitats to those occupied by woodlice. This remarkable little animal can live permanently on land and may have been brought into the country in the soil of tropical plants. Its presence here is due to the transfer of leaf litter and plant soil from other locations around the south of England where it is now widespread, e.g. Kew Gardens (1980) and Battersea Park (1998). It seems to be settled in the garden and it would be interesting to explore its impact on other soil invertebrates such as woodlice. Perhaps this will make an exciting project for the NHM in the future.

Tardigrada (Philip M. Greaves, 4 Combe Common Cottages, Woodside Road, Chiddingfold, Surrey GU8 4QR)

Tardigrades are microscopic invertebrates, typically in the size range 100–750 μm. They are characterized by elongate non-segmented bodies bearing four pairs of short, stumpy legs terminating in claws and 'walk' with a slow, bear-like lumbering gait, hence their common name of water bears. They occur in a wide

range of marine, freshwater and terrestrial habitats across the globe. In terrestrial environments they are usually associated with moss and lichens, but also occur in leaf litter and soils. There are about 90 – 100 recorded species in the UK and around 850 worldwide.

Species found in the Wildlife Garden

Macrobiotus echinogenitus Richters, 1903: a single specimen was isolated from moss taken from the perimeter wall-capping bricks on 17 March 1998 (this was the only tardigrade found in 1998). Several more were found in a sample of moss taken from the path near Queen's Gate on 6 September 2001. The species is cosmopolitan in distribution.

Macrobiotus cf. *hufelandi* Biserov, 1991: found in four of the samples taken in September 2001, this closely related group could not be fully speciated without access to eggs, which were not found in any of the samplings. *M.hufelandi* is, however, the most commonly encountered tardigrade in terrestrial environments.

Hypsibius convergens (Urbanowicz, 1925): many specimens were found in six of the moss samples taken in September 2001. In all cases, the moss was taken from solid stone surfaces. This species also has a cosmopolitan distribution.

Ramazzottius oberhaeuseri (Doyère, 1840): another cosmopolitan species, which was found in only one location in September 2001, moss from the main path near the bridge.

Although the tardigrade fauna so far recorded comprises only a few common species, the study is interesting for two aspects. Firstly, it provides an opportunity to study colonization of a relatively undisturbed site over a period of years, and it adds to our knowledge of tardigrades in urban environments. There has only been one previous report published on tardigrades in London (Greaves 2001), which found a far greater number of species and a greater diversity in the large, well-established garden of Buckingham Palace. Interestingly, the commonest species in the Wildlife Garden, *Hypsibius convergens*, was not encountered in this other study. It is of interest to note the rise in number of species from one in the initial sampling in 1998 to four in 2001; further sampling will try to establish the rate of species migration to the garden, and the maximum number of species that can be maintained.

Terrestrial Mollusca (Peter Mordan, Dept. of Zoology, NHM)

Only five new mollusc species have been recorded from the garden since the first list was published in 1998, bringing the total to twenty-seven. The new records are of *Helix aspersa*, the garden snail, *Vallonia costata*, the ribbed grass snail, *Milax sowerbyi*, Sowerby's slug, *Arion ater*, the black slug, and *Lehmannia marginata*, the tree slug.

Helix aspersa is an extremely widespread snail, probably introduced into Britain by the Romans, which is especially abundant in synanthropic situations. *Arion ater* is a similarly common and widespread slug in gardens, and the occurrence of both these species was to be expected. A much more surprising find is *Lehmannia marginata*. This slug is typical of undisturbed woodlands and rocky areas where it grazes on algae and lichens on the tree trunks or rock surfaces, and must have been introduced into the garden with plants collected from such habitats. It was recorded from the periphery wall. *Milax budapestensis* is our commonest keeled slug, and can become an important pest in vegetable gardens where it burrows and feeds on root crops. *Vallonia costata* is a minute snail normally found living in dry, open areas of short grassland on chalk and limestone. *Vallonia excentrica* has previously been recorded here, and both these species must also have been introduced passively with imported plants.

Populations of several common terrestrial molluscs continue to be supported, including typical garden slugs belonging to the genera *Arion*, *Deroceras* and *Milax*, and snails such as *Discus rotundatus* and *Oxychilus draparnaudi*.

Oligochaeta (earthworms) (John E. Bater, Rothamsted Research, Harpenden, Herts, AL5 2JQ)

Earthworms were sampled from five different habitats as described above and the results are summarized in Table 7. The species found in the different habitats here are fairly typical of similar soil types where they occur naturally. In these very different habitats, concentrations of organic matter as well as pH will play an important role in determining the species composition.

TABLE 7. Earthworm species by habitat.

Habitat code	Habitat type	Species present	Nos of individuals
GO5	Meadow	*Lumbricus terrestris*	5
		Allolobophora chlorotica	1
		Allolobophora rosea	8
GO1	Chalk downland		
WO9	Woodland	*A.caliginosa*	7
		L.terrestris	1
LH01	Heathland	*A. rosea*	1
FO2	Fen	*A. longa*	3
		A.caliginosa	9

VERTEBRATES

Birds (S. M. Swaby, Dept. of Communications and Development, NHM, and Gay Carr, 16 Ringwood Gardens, London SW15 4NP)

The maturing habitats in the garden attract an increasing variety of birdlife. Since 1998, fourteen species have been added to the bird list. While this reflects greater observer coverage in part, it is also an indicator that the garden is proving increasingly attractive to birds.

Systematic list: species recorded 1998–2002.

The nomenclature and sequence follow the official list of the British Ornithologists' Union (1999).

Ardea cinerea grey heron: One was flushed from the margins of the garden pond (A05) on 22 March 2001. Single birds are seen occasionally flying overhead.

Anas platyrhynchos mallard: a frequent visitor to all garden ponds, recorded in all months. Up to five adults have been present, particularly in early spring. Several breeding attempts have been made, most notably in 1998 when a brood of ducklings was raised until they were approximately nine weeks old. No breeding was attempted in 2002, perhaps due to competition from *Gallinula chloropus* common moorhen.

Falco tinnunculus common kestrel: single males and females are occasionally seen over the garden throughout the year; one was seen catching a mouse in the Garden in September 2000 (exact date unknown). Nesting attempts on the Museum's east tower in 1999 and 2000 failed due to egg and chick predation by carrion crow.

Phasianus colchicus common pheasant: a presumed escape present in the garden, 20–21 March 2000 was the second site record.

Gallinula chloropus common moorhen: a first-winter bird took up residence on the main pond from 7 January 2002 following a cold snap, when the Serpentine in Hyde Park and the Long Water in Kensington Gardens were iced-up. This individual was subsequently joined by a mate on 12 March, and the pair bred successfully that spring, raising four young in a specially constructed nestbox that prevented predation by fox. By autumn the juveniles had all dispersed; the adult pair remain resident.

Columba livia feral rock pigeon: resident around the Museum buildings and regularly visits the garden.

Columba palumbus common woodpigeon: a resident pair breed annually in or adjacent to the garden. Small passage movements of the species occur over the Museum during autumn, e.g. 18 birds on 7 October 1999.

Psittacula krameri ring-necked parakeet: a bird in the London plane trees on 27 April 2000 was the first garden recorded.

Dendrocopos major great spotted woodpecker: an occasional visitor to the taller trees in the garden, most recently 23 June 2000. Breeding was reported from Thurloe Square nearby in 2002 (Hewlett 2002).

Motacilla cinerea grey wagtail: a regular winter visitor from September to March, with one or two birds feeding at the main pond. However, in spring 2001 a pair was flushed from the upper pond A08 on 4 May and on four dates in June a single adult was observed collecting insects from water lilies on the main pond A03, which suggests a probable breeding attempt somewhere nearby.

Motacilla alba pied wagtail: one bird was regular in the garden during early 2000.

Troglodytes troglodytes winter wren: the garden has a resident pair, usually breeding in thicker cover and favouring the area around P04. Nesting was successful in 2000 under the eaves of the garden shed; in subsequent years they have favoured less-exposed sites.

Prunella modularis hedge accentor or dunnock: a single bird seen in P05 on 20 November 2002 was the first record in the current monitoring period. The garden certainly offers appropriate habitat for this species, so perhaps further records can be expected.

Erithacus rubecula European robin: resident, breeds in garden. There are at least two pairs holding territory in the Museum grounds.

Turdus merula common blackbird: a conspicuous resident and with up to three breeding pairs within the Museum grounds. The garden is a favoured location throughout the year, with up to six birds feeding in the winter months. Nesting pairs favour the laid hedges H02 and H04, the shrubs in woodland area W09 and the hollies bordering the meadow and chalk habitats.

Turdus philomelos song thrush: a former resident breeder, this species has apparently disappeared from the garden since summer 1999, an absence that perhaps reflects the continued national decline.

Turdus iliacus redwing: occasionally seen or heard in flight over the Museum between October and March, the first record was of two birds on 10 and 19 December 2002, feeding on holly berries.

Turdus viscivorus mistle thrush: a pair breeds in the vicinity of the eastern end of the Museum and is frequently seen feeding in the garden.

Acrocephalus scirpaceus Eurasian reed warbler: a single migrant present in the reedbeds and scrub around the main pond from 9–10 September 2002 was the first since a heard-only record in 1993.

Sylvia atricapilla blackcap: a singing male was seen in PO5 and S01 on the morning of 4 May 1999. This is the second record; the first — also a male — was seen there in April 1998.

Phylloscopus collybita common chiffchaff: an overwintering bird was seen associating with a roving flock of long-tailed tits on 9 December 1999 — the first record for the garden. Another was heard calling on 26 April 2000.

Phylloscopus trochilus willow warbler: a single migrant seen and heard calling on 26 September 2001 was the first site record.

Regulus regulus goldcrest: a rare winter visitor, most recently seen on 26 November 1999 in S02. It usually accompanies mixed flocks of tits.

Aegithalos caudatus long-tailed tit: a pair attempted to breed twice in the garden during April 2002, but both nests were abandoned. It is also a frequent visitor during the winter months, occurring in small roving flocks of up to thirteen.

Parus caeruleus blue tit: a resident breeder, seen regularly all year. Often in company with great tit outside the breeding season.

Parus major great tit: present all year, with successful breeding confirmed annually in 2000–2002 at least.

Garrulus glandarius Eurasian jay: a regular visitor. A pair successfully reared a brood here for the first time in June 1999, and annually since.

Pica pica black-billed magpie: seen regularly in the area, usually in pairs, but a surprisingly infrequent visitor to the garden.

Corvus corone carrion crow: at least one pair breeds locally; it is frequently seen in or close to the garden, perching in the plane trees. Maximum count: 14 on 7 October 1999.

Sturnus vulgaris common starling: a regular visitor, seen in all months but present in larger numbers during winter.

Passer domesticus house sparrow: three birds seen on 17 June 2002 in P04 constituted the first record of the current monitoring period; these probably originated from the shrinking population in Hyde Park and Kensington Gardens. A single bird was seen on 3 July 2002.

Fringilla coelebs chaffinch: a female foraging in the garden's woodland areas on several occasions during April 2000 provided the first site record. Further sightings are expected; it could also be a potential future breeder in the garden.

Carduelis chloris European greenfinch: three birds seen flying north over the Museum on 2 July 1999 was the first record in the current monitoring period. It has since become a regular visitor to the garden after the introduction of a feeding station in March 2002, and a pair bred successfully in the vicinity that spring, raising four young.

Carduelis carduelis European goldfinch: a rare visitor, with single birds in December 1997, 17 January 2001 and 2 November 2002, no doubt attracted by the alder tree by the ponds.

Amphibia and Reptilia (Caroline Ware, Dept. of Visitor and Operational Services, NHM)

The amphibian population of common frog *Rana temporaria*, toad *Bufo bufo* and smooth newt *Triturus vulgaris* has increased over the last five years, sufficiently so to attract the occasional passing heron. Following the recommendation of Atkins and Herbert (1997) frog and toad spawn were introduced into the main pond (A03) and chalk pond (A01) in 1998 and 1999.

The appearance of one clump of frogspawn in the main pond in March 1999 was the earliest evidence of frogs breeding in the garden during the survey period. The rate of breeding has since increased in the main pond to five clumps in 2000, approximately 10 in 2001 and 15 – 30 in 2002. Toad spawn is less easy to spot but several chains of spawn were observed around stalks of *Glyceria maxima* reed sweet-grass in March 2002. The six–eight week-old frog and toad tadpoles were found each year congregating in the warm shallows of the ford and beside the pond-dipping platform. Many of the newly formed froglets (too numerous to count) are encountered in the summer along the pond banks and in the meadow and chalk downland. Older frogs and toads ranging in size from 3 cm to full size are frequently observed around the pond edges, fen and ditch, and in winter under leaves and log piles.

There have been no further introductions of smooth newt since July 1995. During a night-time survey (Meade 2002) 22 newts were counted in the main pond (A03), 17 in the chalk pond (A01) and 3 in the upper pond (A08) compared to 7 in the main pond only, in March 1995. The figures for the upper pond in 2002 are almost certainly an underestimate as the limit of visibility was not more than 30 cm. Much of our evidence of a thriving newt population also comes from informal observation. Clearing the pond of blanket weed and duckweed entails rigorous checking for aquatic fauna and in this process many newts and newt tadpoles are rescued and returned to the pond. Pond net sweeps during school workshops also collect newts, which are returned. Several less fortunate newts have been found dead in pitfall traps. As with frogs and toads, live newts are also inadvertently disturbed hibernating under logs and stones in all areas of the garden.

It is impossible to quantify the numbers but whereas five years ago it was a rare surprise to find a frog, toad or newt whilst working in the garden, it is now a common occurrence. Predators of frog and toad spawn and tadpoles, such as heron, mallard and moorhen as well as newts help to regulate the increased frog and toad population.

One slow worm *Anguis fragilis* was observed while planting the wet heathland turfs brought in from Slop Bog, Dorset in February 1999. There have been no further sightings.

Mammals (Richard Harbord, Dept. of Zoology, NHM)

Nine mammal species have been recorded in the garden. The activities of some are clearly seen: foxes *Vulpes vulpes* have made earths and flattened the grass and grey squirrels *Sciuris carolinensis* are seen in trees and shrubs. But there are others that, like most and other British mammal fauna, are difficult to see and therefore record. Using the hair trap method described above, we were able to determine the presence and identity of house mouse *Mus musculus* and wood mouse *Apodemus sylvaticus*. We were particularly pleased to record the wood mouse as still present here. Squirrels are seen regularly, especially in the woodland habitats in the north of the garden. There has also been one unconfirmed sighting of a field vole *Microtus agrestis*. Rats *Rattus norvegicus* are considered a pest in inner London but there has been just one sighting in the garden in the last five years.

Bats (John Tovey, London Bat Group)

Bats are monitored using bat detectors. They usually only stay for a few minutes as this is only one of their feeding stations during the evening. The bat boxes mounted high in the trees have not been used to date. We have seen two *Pipistrelle* species feeding at the site, *P. pipistrellus* and *P. pygmaeus* and just a single individual of each. A daytime fly-by of a Daubenton's bat *Myotis daubentoni* was also recorded over the pond. For more details about bats in London see The London Bat Group website at http://www.londonbats.org.uk/

ENVIRONMENT

Air quality (Anja Tremper, University of Hertfordshire)

As part of a PhD project concerning the active biomonitoring of traffic-related particles and their associated metals, Anja Tremper from the University of Hertfordshire has used the garden as one of her roadside sampling sites. Two species of moss, *Rhytidiadelphus squarrosus* and *Pleurozium schreberi* (collected from sites outside London), were placed in the garden in mesh-covered boxes, after cleaning and preparation.

The mosses were exposed at a total of five sites in London and Hertfordshire, ranging from background sites to roadside sites to measure the metal deposition. The exposure times were two weeks in summer 2001, autumn 2001, winter 2001/2 and spring 2002. The Wildlife Garden was only included from autumn 2001 as an additional roadside site adjacent to the AUN (Automatic Urban Network) monitoring site in Cromwell Road.

After exposure the mosses were analysed for their metal and chlorophyll content. The metals analysed were iron, copper, lead, zinc and nickel. The chlorophyll concentration, which was measured as a possible indicator of the response of the mosses to stress, had not decreased in comparison to mosses exposed in a controlled environment, a similar finding as at other sites. The mosses exposed in the garden, however, had the highest concentrations of the metals iron and lead compared with the other sites, especially in the autumn and winter periods.

Air pollution monitoring. (S. Honour, S.A. Power and J.N.B. Bell, Environmental Measurement, Modelling and Assessment Group (EMMA), Department of Environmental Science and Technology, Imperial College of Science, Technology and Medicine)

Imperial College have also carried out an air pollution monitoring survey in the garden, in this case using higher plant species.

This seeks to assess the levels of air pollution to which urban plants are exposed. Situated in a polluted part of Central London and bordering

Cromwell Road, the garden is an ideal site to study. In addition, the DEFRA air pollution monitoring station in the south-west corner of the garden, provides vital information about local levels of key pollutants. The study looked at the concentrations and spatial distribution within the garden of a range of urban air pollutants. For this article, however, we shall be looking only at the two most common air pollutants: nitric oxide (NO) and nitrogen dioxide (NO_2).

Methodology

Air pollution monitoring took place at five sites within the garden, at different distances from Cromwell Road. On six separate occasions from 18 October 2001 to 9 July 2002, NO and NO_2 were measured simultaneously using Model 3300 Ogawa™ Passive Samplers (EMC Environment Limited, Cheltenham, Glos.). In accordance with the manufacturer's instructions, samplers were exposed to ambient air for between two–four weeks before being taken to the laboratory for analysis. The Cromwell Road DEFRA air pollution monitoring station is part of the automatic pollution recording network and makes continuous measurements of carbon monoxide, sulphur dioxide, nitric oxide and nitrogen dioxide. Data from this site are available at www.airqual.co.uk

Results and discussion

Air pollution concentrations

There are two main nitrogen oxide pollutants, nitric oxide (NO) and nitrogen dioxide (NO_2), which together are known as NO_x. These two oxides are often grouped together because most NO_2 in the urban environment is derived from NO and the chemistry of the two pollutants is closely linked. In urban areas the principle source of nitrogen pollution is road traffic emissions. Most NO_x is emitted in the form of NO, however, this is rapidly oxidized in the environment to NO_2.

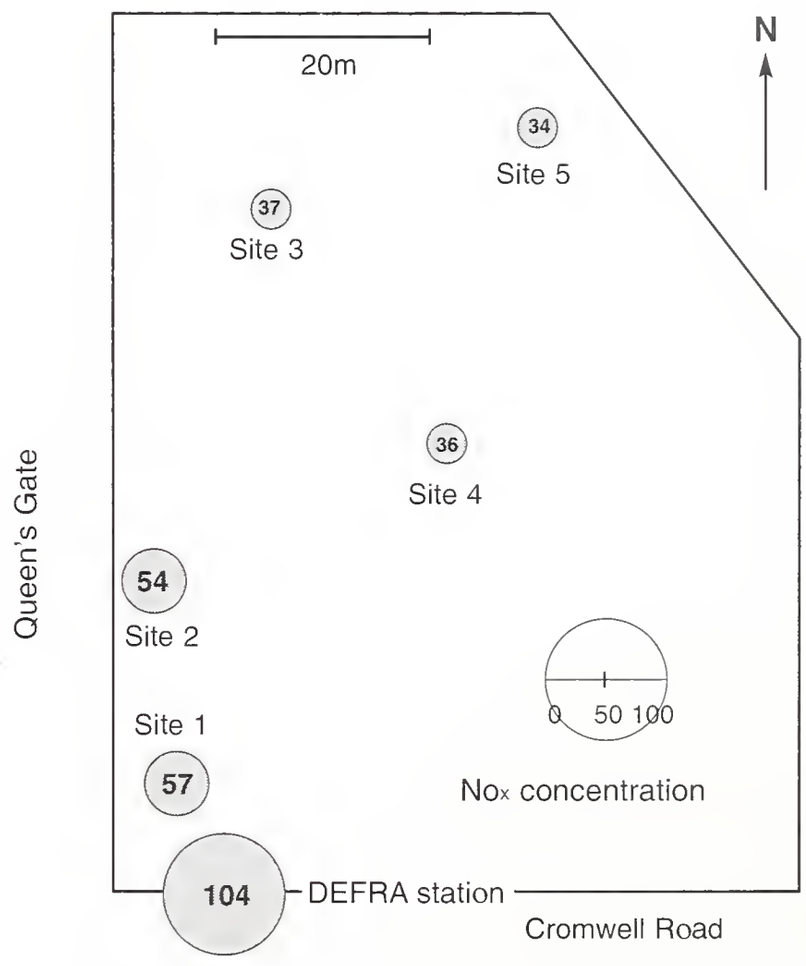

FIGURE 8. Concentrations of nitrogen oxides for the monitoring station and five sites in the Wildlife Garden.

Figure 8 shows the location and NO_x concentrations for the five monitoring sites in the garden together with the DEFRA monitoring station. It is immediately apparent that the levels of nitrogen oxides recorded by the monitoring station are significantly higher than those within the garden. Although the methods used to measure the pollutants in the garden and at the monitoring site are different, experiments have shown good agreement between the two techniques (Smith et al. 1999) and this is unlikely to be the cause of the disparity. The main reason is probably the difference in distance from CromwellRoad, the main source of pollution, to the different sites. The intake for the monitoring station is only 3 m from the road edge whilst the sites in the garden range from 15–75 m from Cromwell Road. The sunken nature of the garden together with the barrier formed by surrounding vegetation, particularly in summer, might also be expected to afford the garden some protection from the ingress of traffic-derived pollution.

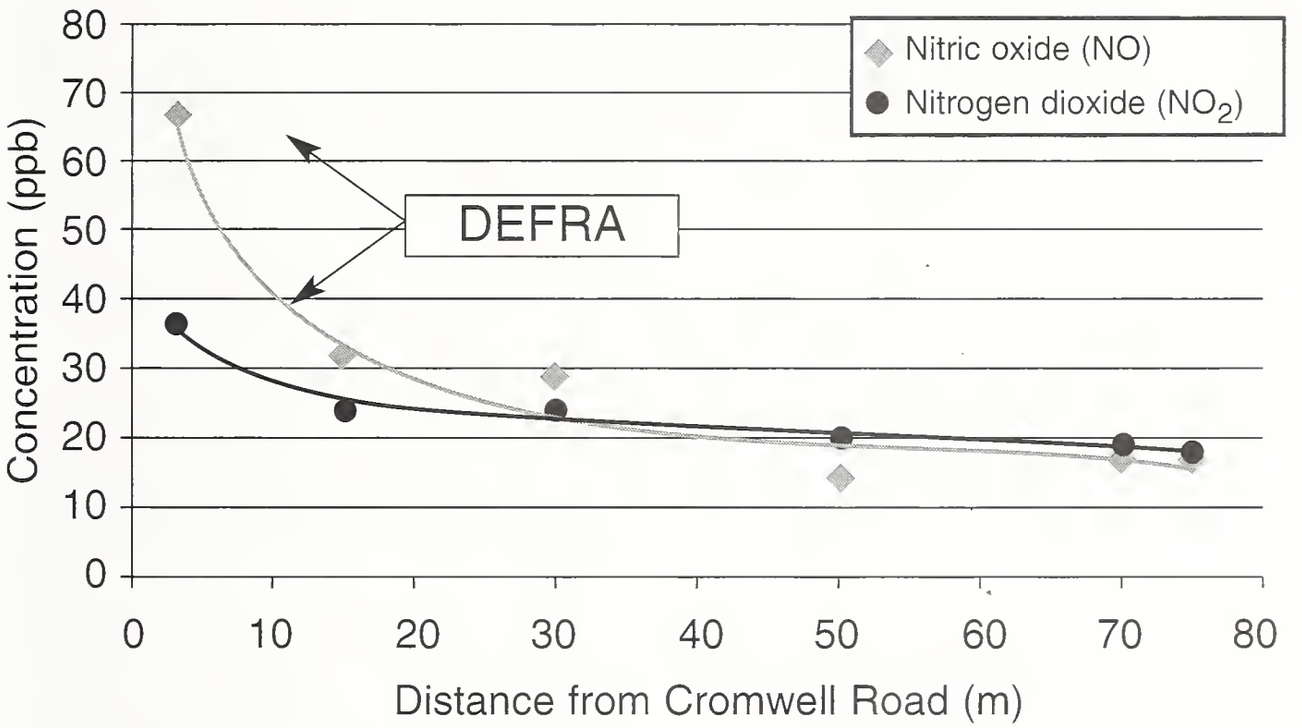

FIGURE 9. Nitric oxide and nitrogen dioxide concentrations with distance from Cromwell Road. Results are the average of six separate sampling periods from 18.x.2001–9.vii.2002.

Studies have shown that traffic-derived pollutants decline with increasing distance from the road, as the exhaust gases and their products become diluted with ambient air (Kuhler et al. 1994; Roorda-Knape et al. 1998; Hitchins et al. 2000). By looking at the NO concentrations shown in Figure 9, it is apparent that this is the case in the garden, with sites closest to the road having higher levels than those further away. The concentrations of NO_2 show a similar trend to NO, however, the levels close to the road are much smaller and the decline in concentration less steep. This is because NO_2 is predominantly a secondary pollutant i.e. it is formed by reactions in the environment rather than through direct emission. Although it is formed fairly quickly in the urban environment from vehicle emissions, it only undergoes further reactions on a longer timescale. This leads to elevated concentrations of the pollutant over entire urban areas as well as enhanced levels close to roads. The general background NO_2 concentration for the period of monitoring can be assessed by looking at results from the nearby North Kensington monitoring station, which is situated away from the direct influence of roads. That site recorded an average NO_2 concentration of 21 parts per billion (ppb), which is similar to the lowest levels found in the Wildlife Garden, at the northern end. This suggests that the

influence of Cromwell Road on NO_2 concentrations is only significant close to the road.

The air pollution monitoring showed a decline in both NO and NO_2 across the garden, away from Cromwell Road. Average concentrations of NO in the garden ranged from 33 to 16 ppb whilst levels of NO_2 ranged from 25 to 18 ppb. It should, however, be noted that all the data shown here represent long-term averages. On a daily and hourly basis NO_x concentrations, particularly NO levels, can vary significantly due to temporal changes in road traffic density and climatic conditions. Under certain conditions the actual pollutant concentrations experienced may be significantly higher or lower than the long-term averages.

Potential plant effects

Having measured the levels of NO_x pollution in the garden, it is important to determine whether these concentrations could have a biological effect on the at other studies to begin to address this question. Nitrogen is a major plant nutrient and therefore vegetation can show a complex response to NO_x pollution. Low pollutant concentrations can result in growth stimulation, however, higher levels of NO_x can lead to growth inhibition. NO_x pollution has also been shown to affect a range of other plant parameters including plant phenology and physiology.

Experiments have tended to show that NO_2 is more damaging to plants than NO, especially at very high concentrations. Little work, however, has been carried out on NO using long term exposure to typical urban concentrations and the potential for damaging effects, especially in combination with other pollutants, cannot be ruled out. Other studies have shown that long-term exposure to concentrations as low as 15 – 40 ppb NO_2 can have measurable effects on plants (Adaros et al. 1991; Bender et al. 1991; Nasholm et al. 1991; Morgan et al. 1992) The urban environment contains pollutants other than NO and NO_2 such as volatile organic compounds, sulphur dioxide, ozone and particulates. These pollutants have also been shown to have adverse effects on plants, although always at concentrations higher than those commonly found in the environment. Possible interactions, both between different pollutants and involving environmental stresses such as drought and frost, however, means that these compounds still have the potential to cause damage to plants. Studies have shown that the levels of vehicle emissions currently found in our urban areas can cause a range of damaging effects, not only to sensitive species such as lichens, but to a range of herbaceous plants, trees and shrubs. (Spencer et al. 1988, Gratani et al. 2000, Moonen et al. 1999, Viskari et al. 2000).

In its Air Quality Strategy (DETR 2000), the Department of the Environment, Transport and the Regions recognized the potential damage relatively low levels of NO_x can cause to plants. It set an Air Quality Objective for the protection of ecosystems of 16 ppb NO_x, as an annual mean. This objective, unfortunately, does not apply to built-up areas of more than 5,000 people and therefore does not cover the London area. However, it is clear that plants in the garden are exposed to NO_x concentrations considerably higher than this level. It is therefore possible than some sensitive species are affected by the current levels of NO_x pollution. Although the effects on individual plants are likely to be quite subtle, such as small changes in plant growth or photosynthetic rate, or increased sensitivity to stress, this does not mean they are unimportant. Plants in the natural environment are in constant competition with their neighbours for resources and experience high levels of environmental stress. Therefore even relatively small changes in the competitive ability or vitality of individual plants or species can lead to changes in the species composition of plant communities.

Species lists

All species recorded in the garden between 1998 and 2003

FLORA and FUNGI

Freshwater algae

CHLOROPHYTA
Green Algae
Ankistrodesmus falcatus
Ankistrodesmus fusiformis
Aphanochaete repens
Apiocystis brauniana
Botryococcus braunii
Characium sp.
*Chlamydomonas*sp.
Chlorella sp.
Chlorococcum humicola
Chlorosarcinopsis sp.
Cladophora glomerata
Closterium acerosum
Closterium ehrenbergii
Closterium littorale
Closterium parvulum
Closterium tumidulum
Coleochaete scutata
Cosmarium botrytis
Cosmarium obtusatum
Cosmarium subcrenatum
Crucigeniella rectangularis
Desmococcus olivaceum
Dictyosphaerium ehrenbergianum
Elakatothrix inflexa
Eudorina sp.
Golenkinia radiata
Gongrosira sp.
Gonium sp.
Hydrodictyon reticulatum
Klebsormidium flaccidum
Lobomonas rostrata
Micractinium pusillum
Microthamnion kuetzingianum
Monoraphidium tortile
Mougeotia spp.
Oedogonium spp.
Oocystis solitaria
Pediastrum boryanum
Pediastrum duplex
Pediastrum tetras
Phacotus lenticularis
Pteromonas angulosa
Rhizoclonium hieroglyphicum
Scenedesmus communis
Scenedesmus pannonicus
Schizochlamydella delicatula
Sphaerocystis schroeteri
Spirogyra sp.
Staurastrum ophiura
Staurastrum planktonicum
Stichoccus bacillaris
Tetracystis pulchra
Tetraedron minimum
Ulothrix sp.
Volvox aureus

CYANOPHYTA
Blue-green Algae
Anabaena circinalis
Anabaena cylindrica
Chroococcus turgidus
Chroococcus sp.
Gomphosphaeria aponina
Lygnbya sp.
Merismopedia glauca
Microcystis aeruginosa
Nostoc commune
Nostoc sp.
Oscillatoria limosa
Oscillatoria sp.
Pseudanabaena sp.
Synechococcus aeruginosus
Synechococcus sp.

EUGLENOPHYTA
Euglenoid Algae
Euglena agilis
Euglena deses
Euglena elastica
Euglena sanguinea
Euglena sp.
Lepocinclis fusiformis
Lepocinclis marsonnii
Lepocinclis ovum
Phacus acuminatus
Phacus agilis
Phacus caudatus
Phacus orbicularis
Phacus pleuronectes
Phacus pseudonordstedii
Phacus pyrum
Phacus similis
Trachelomonas hispida var. *crenulatocollis*
Trachelomonas hispida
Trachelomonas volvocinopsis
Trachelomonas sp.

CHRYSOPHYTA
Chromophyton rosanoffi
Chromulina sp.

CRYPTOPHYTA
Cryptomonas ovata

PYRROPHYTA
Peridinium cinctum

XANTHOPHYTA
Botrydiopsis arriza
Characiopsis pyriformis
Characiopsis turgida
Ophiocytium arbusculum
Tribonema utriculosum
Tribonema vulgare
Vaucheria sp.

Vascular plants. Nomenclature follows Stace (1997).
1 – Relic from previous garden, 2 – Accidental arrival.

Pteridophytes

ASPLENIACEAE
Phyllitis scolopendrium hart's-tongue

BLECHNACEAE
Blechnum spicant hard-fern

DENNSTAEDTIACEAE
Pteridium aquilinum bracken

DRYOPTERIDACEAE
Dryopteris affinis ssp. *borreri* scaly male-fern
Dryopteris dilatata broad buckler-fern
Dryopteris filix-mas male-fern
Polystichum setiferum soft shield-fern

EQUISETACEAE
Equisetum arvense[2] field horsetail
Equisetum fluviatile water horsetail

POLYPODIACEAE
Polypodium vulgare polypody

THELYPTERIDACEAE
Thelypteris palustris marsh fern

WOODSIACEAE
Athyrium filix-femina lady-fern

Angiosperms

ACERACEAE
Acer campestre field maple
Acer pseudoplatanus[2] sycamore

APIACEAE
Aegopodium podagraria[1] ground-elder
Aethusa cynapium fool's parsley
Angelica sylvestris wild angelica
Anthriscus caucalis bur parsley
Anthriscus sylvestris cow parsley
Berula erecta lesser water-parsnip
Cicuta virosa cowbane
Daucus carota s.s. wild carrot
Heracleum sphondylium hogweed
Peucedanum officinale hog's fennel
Peucedanum palustre milk-parsley
Sison amomum stone parsley
Torilis japonica upright hedge-parsley

AQUIFOLIACEAE
Ilex aquifolium holly
Ilex aquifolium cv. *'Highclere'*[1] Highclere holly
Ilex seedling holly seedling

ARACEAE
Arum maculatum lords-and-ladies

ARALIACEAE
Hedera helix ivy

ARISTOLOCHIACEAE
Asarum europaeum[2] asarabacca

ASTERACEAE
Achillea millefolium yarrow
Arctium minus lesser burdock
Artemisia vulgaris[2] mugwort
Bellis perennis daisy
Centaurea nigra common knapweed
Cichorium intybus chicory
Cirsium arvense[2] creeping thistle
Cirsium vulgare[2] spear thistle
Conyza canadensis[2] Canadian fleabane
Conyza sumatrensis[2] Guernsey fleabane
Eupatorium cannabinum hemp-agrimony
Hypochaeris radicata cat's-ear
Lactuca serriola[2] prickly lettuce
Lapsana communis[2] nipplewort
Leontodon autumnalis autumn hawkbit
Leontodon hispidus rough hawkbit
Leucanthemum vulgare oxeye daisy
Picris echioides[2] bristly oxtongue
Picris hieracioides[2] hawkweed oxtongue
Pilosella aurantiacum orange hawkweed
Pulicaria dysenterica common fleabane
Senecio jacobaea[2] common ragwort
Sonchus asper[2] prickly sow-thistle
Sonchus oleraceus[2] smooth sow-thistle
Sonchus sp.[2] sow-thistle seedling
Tanacetum parthenium[2] feverfew
Tanacetum vulgare[2] tansy
Taraxacum officinale agg[2] dandelion
Tripleurospermum inodorum[2] scentless mayweed
Tussilago farfara[2] coltsfoot

BERBERIDIACEAE
Berberis gagnepainii[1] Gagnepain's barberry
Mahonia aquifolium[1] Oregon grape

BETULACEAE
Alnus glutinosa alder
Betula pendula silver birch
Betula pubescens downy birch
Carpinus betulus hornbeam
Corylus avellana hazel

BORAGINACEAE
Myosotis scorpioides water forget-me-not
Pentaglottis sempervirens[1] green alkanet
Symphytum officinale common comfrey

BRASSICACEAE
Alliaria petiolata garlic mustard
Barbarea vulgaris winter cress
Capsella bursa-pastoris[2] shepherd's purse
Cardamine flexuosa[2] wavy bitter cress
Cardamine pratensis cuckoo flower
Hirschfeldia incana[2] hoary mustard
Sisymbrium officinale[2] hedge mustard

BUDDLEJACEAE
Buddleja davidii butterfly bush

BUTOMACEAE
Butomus umbellatus flowering-rush

BUXACEAE
Buxus sempervirens[1] box

CALLITRICHACEAE
Callitriche stagnalis common water-starwort

CAMPANULACEAE
Campanula glomerata clustered bellflower
Campanula rotundifolia harebell
Campanula trachelium nettle-leaved bellfower

CANNABACEAE
Humulus lupulus hop

CAPRIFOLIACEAE
Leycesteria formosa[1] Himalayan honeysuckle
Lonicera periclymenum honeysuckle
Sambucus nigra elder
Symphoricarpos albus[1] snowberry
Viburnum lantana wayfaring tree
Viburnum opulus guelder rose

CARYOPHYLLACEAE
Cerastium fontanum[2] common mouse-ear
Lychnis flos-cuculi ragged robin
Silene dioica red campion
Silene latifolia ssp. *alba* white campion
Silene vulgaris bladder campion
Stellaria holostea greater stitchwort
Stellaria media[2] common chickweed

CELASTRACEAE
Euonymus europaeus spindle
Euonymus japonicus[1] evergreen spindle

CERATOPHYLLACEAE
Ceratophyllum demersum rigid hornwort

CHENOPODIACEAE
Atriplex sp.[2] orache sp.
Chenopodium album[2] fat hen
Chenopodium sp.[2] goosefoot sp.

CISTACEAE
Helianthemum nummularium common rock-rose

CLUSIACEAE
Hypericum androsaemum tutsan
Hypericum hirsutum hairy St John's-wort
Hypericum perforatum perforate St John's-wort
Hypericum tetrapterum square-stalked St John's-wort

CONVOLVULACEAE
Calystegia pulchra[2] hairy bindweed
Calystegia sepium[2] common bindweed
Calystegia silvatica[2] large bindweed
Convolvulus arvensis[2] field bindweed

CORNACEAE
Aucuba japonica[1] spotted laurel
Cornus sanguinea dogwood
Cornus alba 'Sibirica' red-barked dogwood

CUPRESSACEAE
Juniperus communis common juniper

CYPERACEAE
Carex acutiformis lesser pond-sedge
Carex flacca glaucous sedge
Carex pendula pendulous sedge
Carex riparia greater pond-sedge
Carex sylvatica wood-sedge
Cladium mariscus great fen-sedge
Cyperus longus galingale

DIPSACACEAE
Dipsacus fullonum wild teasel
Knautia arvensis field scabious
Scabiosa columbaria small scabious
Succisa pratensis devil's-bit scabious

ERICACEAE
Calluna vulgaris heather
Erica cinerea bell heather
Vaccinium myrtillus bilberry

EUPHORBIACEAE
Euphorbia amygdaloides wood spurge
Euphorbia peplus[2] petty spurge
Mercurialis annua[2] annual mercury
Mercurialis perennis dog's mercury

FABACEAE
Anthyllis vulneraria kidney vetch
Cytisus scoparius broom
Lathyrus nissolia[2] grass vetchling
Lathyrus pratensis meadow vetchling
Lotus corniculatus common bird's-foot-trefoil
Lotus pedunculatus greater bird's-foot-trefoil
Medicago lupulina black medick
Ononis repens common restharrow
Trifolium dubium lesser trefoil
Trifolium pratense red clover
Trifolium repens white clover
Ulex europaeus gorse
Ulex gallii western gorse
Ulex minor dwarf gorse
Vicia cracca tufted vetch
Vicia hirsuta[2] hairy tare
Vicia sativa[2] common vetch

FAGACEAE
Fagus sylvatica beech
Quercus ilex[1] evergreen oak
Quercus petraea sessile oak
Quercus robur pedunculate oak
Quercus seedling oak seedling

GENTIANACEAE
Blackstonia perfoliata yellow-wort
Centaurium erythraea[2] common centaury

Geranium pratense	meadow cranesbill
Geranium pyrenaicum	hedgerow cranesbill
Geranium robertianum[2]	herb robert
Geranium rotundifolium	round-leaved cranesbill
Geranium sylvaticum	wood cranesbill
Geranium × *oxonianum*	Druce's cranesbill

HALORAGACEAE

Myriophyllum spicatum	spiked water-milfoil

HIPPOCASTANACEAE

Aesculus hippocastanum[1]	horse chestnut

HIPPURIDACEAE

Hippuris vulgaris	mare's tail

HYDRANGEACEAE

Philadelphus coronarius[1]	mock orange

HYDROCHARITACEAE

Elodea canadensis	Canadian waterweed

IRIDACEAE

Iris foetidissima	stinking iris
Iris pseudacorus	yellow iris

JUNCACEAE

Juncus articulatus	jointed rush
Juncus effusus	soft-rush
Juncus inflexus	hard rush

LAMIACEAE

Ajuga reptans	bugle
Ballota nigra[2]	black horehound
Clinopodium vulgare	wild basil
Galeopsis tetrahit[2]	common hemp-nettle
Glechoma hederacea	ground-ivy
Lamiastrum galeobdolon	yellow archangel
Lamium album[2]	white dead-nettle
Lycopus europaeus	gipsywort
Mentha aquatica	water mint
Origanum vulgare	wild marjoram
Prunella vulgaris	selfheal
Salvia verbenaca	wild clary
Scutellaria galericulata	skullcap
Stachys arvensis[2]	field woundwort
Stachys officinalis	betony
Stachys sylvatica	hedge woundwort
Teucrium scorodonia	wood sage
Thymus polytrichus	wild thyme

LEMNACEAE

Lemna gibba[2]	fat duckweed
Lemna minor[2]	common duckweed
Lemna minuta[2]	least duckweed
Lemna trisulca[2]	ivy-leaved duckweed

LILIACEAE

Allium triquetrum[2]	three-cornered garlic
Allium ursinum	ramsons
Hyacinthoides hispanica	Spanish bluebell
Hyacinthoides non-scripta	bluebell
Narcissus pseudonarcissus	wild daffodil
Ruscus aculeatus	butcher's broom

LINACEAE

Linum catharticum	fairy flax

LYTHRACEAE

Lythrum salicaria	purple loosestrife

MALVACEAE

Malva moschata	musk-mallow
Malva sylvestris[2]	common mallow

MENYANTHACEAE

Menyanthes trifoliata	bogbean
Nymphoides peltata	fringed water-lily

MYRICACEAE

Myrica gale	bog myrtle

NYMPHAEACEAE

Nymphaea alba	white water-lily

OLEACEAE

Fraxinus excelsior	ash
Ligustrum lucidum[1]	shiny privet
Ligustrum ovalifolium[1]	garden privet
Ligustrum vulgare	wild privet

ONAGRACEAE

Chamerion angustifolium[2]	rosebay willowherb
Circaea lutetiana	enchanter's nightshade
Epilobium hirsutum	great willowherb
Epilobium roseum[2]	pale willowherb
Epilobium seedling[2]	willowherb seedling
Oenothera biennis	common evening primrose

ORCHIDACEAE

Dactylorhiza fuchsii	common spotted orchid
Dactylorhiza maculata	heath spotted orchid
Spiranthes aestivalis	summer lady's-tresses

OXALIDACEAE

Oxalis acetosella	wood-sorrel

PINACEAE

Pinus sylvestris	Scots pine

PLANTAGINACEAE

Plantago lanceolata	ribwort plantain
Plantago major[2]	greater plantain
Plantago media	hoary plantain

PLATANACEAE

Platanus × *hispanica*[1]	London plane

POACEAE

Agrostis capillaris	common bent
Agrostis curtisii	bristle bent
Agrostis stolonifera	creeping bent
Alopecurus pratensis	meadow foxtail
Anisantha diandra	great brome
Anisantha sterilis[2]	barren brome
Anthoxanthum odoratum	sweet vernal grass
Arrhenatherum elatius	false oat grass
Brachypodium pinnatum	tor grass
Brachypodium sylvaticum	false brome
Bromopsis erecta	upright brome
Bromus hordeaceus	soft brome
Briza media	quaking grass
Cynosurus cristatus	crested dog's tail
Dactylis glomerata	cock's foot
Deschampsia cespitosa	tufted hair grass
Elytrigia repens[2]	common couch
Festuca ovina s.s.	sheep's fescue
Festuca rubra	red fescue
Glyceria maxima	reed sweet grass
Helictotrichon pratense	meadow oat grass
Holcus lanatus	Yorkshire-fog
Hordeum murinum[2]	wall barley
Lolium perenne	perennial rye grass
Koeleria macrantha	crested hair grass
Melica uniflora	wood mellick
Milium effusum	wood millet
Molinia caerulea	purple moor grass
Phalaris arundinacea	reed canary grass
Phleum bertolonii	smaller cat's tail
Phleum pratense	timothy
Phragmites australis	common reed
Poa annua[2]	annual meadow-grass
Poa nemoralis	wood meadow-grass
Poa trivialis	rough meadow-grass
Trisetum flavescens	yellow oat-grass

POLYGONACEAE

Persicaria maculosa[2]	redshank
Polygonum aviculare[2]	knotgrass
Rumex acetosa s.s.	common sorrel
Rumex conglomeratus[2]	clustered dock
Rumex hydrolapathum	water dock
Rumex obtusifolius[2]	broad-leaved dock
Rumex sanguineus	wood dock
Rumex sp.[2]	dock species or seedling

POTAMOGETONACEAE

Potamogeton crispus	curled pondweed

PRIMULACEAE

Lysimachia nummularia	creeping jenny
Lysimachia vulgaris	yellow loosestrife
Primula elatior	oxslip
Primula veris	cowslip
Primula vulgaris	primrose

RANUNCULACEAE

Anemone nemorosa	wood anemone
Aquilegia vulgaris	columbine
Caltha palustris	marsh marigold
Clematis vitalba	traveller's joy
Ranunculus acris	meadow buttercup
Ranunculus bulbosus	bulbous buttercup
Ranunculus ficaria	lesser celandine
Ranunculus lingua	greater spearwort
Ranunculus repens	creeping buttercup
Ranunculus sceleratus	celery-leaved buttercup
Thalictrum flavum	common meadow rue

RESEDACEAE

Reseda lutea	wild mignonette

RHAMNACEAE

Rhamnus cathartica	buckthorn
Frangula alnus	alder buckthorn

ROSACEAE

Agrimonia eupatoria	agrimony
Cotoneaster integerrimus	wild cotoneaster
Crataegus monogyna	hawthorn
Crataegus laevigata[1]	Midland hawthorn
Filipendula ulmaria	meadowsweet
Fragaria vesca	wild strawberry
Geum rivale	water avens
Geum urbanum	wood avens
Malus sylvestris	crab apple
Malus cv. Rev. W. Wilks	
Malus cv. Arthur Turner	
Malus cv. Brownlees Russet	
Potentilla anserine	silverweed
Potentilla reptans[2]	creeping cinquefoil
Prunus avium	wild cherry
Prunus laurocerasus[1]	cherry laurel
Prunus padus	bird cherry
Prunus seedling	cherry seedling
Prunus spinosa	blackthorn
Rosa arvensis	field-rose
Rosa canina	dog-rose
Rubus fruticosus agg.	bramble
Rubus armeniacus cv. Himalayan Giant[2]	
Rubus euryanthemus W.C.R.Watson[2]	
Rubus 'False *crespignyanus*'	
Rubus polyanthemus [2]	
Sanguisorba minor ssp. *minor*	salad burnet
Sanguisorba officinalis	great burnet
Sorbus aria	common whitebeam
Sorbus aucuparia	rowan
Sorbus seedling	rowan seedling
Sorbus torminalis	wild service tree

RUBIACEAE

Galium aparine[2]	goosegrass
Galium mollugo	hedge bedstraw
Galium odoratum	woodruff
Galium verum	lady's bedstraw

SALICACEAE

Populus nigra 'Italica'[2]	Lombardy poplar
Salix alba × *S. fragilis*	
Salix aurita	eared willow
Salix caprea	goat willow
Salix cinerea	grey willow
Salix sp.	willow species

SCROPHULARIACEAE

Digitalis purpurea	foxglove
Linaria vulgaris	common toadflax
Rhinanthus minor	yellow-rattle
Scrophularia auriculata	water figwort
Scrophularia nodosa	figwort
Scrophularia sp.	scrophularia seedling
Verbascum nigrum	dark mullein
Verbascum thapsus	great mullein
Veronica beccabunga	brooklime
Veronica chamaedrys	germander speedwell
Veronica hederifolia[2]	ivy-leaved speedwell
Veronica persica[2]	common field speedwell
Veronica serpyllifolia[2]	thyme-leaved speedwell

SOLANACEAE

Solanum dulcamara[2]	bittersweet

SPARGANIACEAE

Sparganium erectum	branched bur-reed

TAXACEAE

Taxus baccata	yew

TILIACEAE

Tilia cordata[1]	small-leaved lime

URTICACEAE

Urtica dioica[1]	common nettle
Urtica galeopsifolia	fen nettle

VIOLACEAE

Viola odorata	sweet violet
Viola riviniana	common dog violet

Fungi with host or substrate

Toadstools and allies (Basidiomycetes)

Agaricus silvaticus	on soil
Auricularia auricula-judae	on dead branches
Auricularia mesenterica	*Fraxinus* stump
Bjerkandera adusta	on laid hedge
Boletus chrysenteron	on soil
Botryobasidium aureum (*Alysidium dubium* state)	on rotten wood
Byssomerulius corium	*Corylus* dead wood
Choudrostereum purpureum	*Populus* dead branch; old log
Clitocybe dealbata	on soil
Coniophora puteana	old stump
Conocybe striaepes	on soil
Coprinus atramentarius	on soil amongst grass
Coprinus comatus	on soil
Coprinus disseminatus	*Populus* log
Coprinus leiocephalus	on soil
Cylindrobasidium laeve (= *evolvens*)	*Philadelphus* wood; *Populus* dead branch
Dacrymyces stillatus	*Aucuba* rotten branch
Exidia nucleata	*Fraxinus* stump
Flammulina velutipes	on rotten branch
Hebeloma leucosarx	on soil
Hyphoderma praetermissum	on rotten log
Hyphodontia sambuci	base of dead *Malus*; *Populus* dead twigs; logs
Hypholoma fasciculare	old stumps and logs
Inocybe fuscidula	on soil near *Populus*
Kuehneromyces mutabilis	on old log
Laccaria laccata	on soil
Lacrymaria velutina	on soil amongst grass
Lepiota cristata	on soil
Lepiota subincarnata	on soil

Lepista nuda	on soil
Lyophyllum decastes	on soil
Marasmius rotula	on wood of *Syringa*
Merismodes anomalus	on dead branch
Mycena galopus var. *nigra*	on soil
Mycena sanguinolenta	on decorticated branch
Mycoacia fuscoatra	underside of *Populus* log
Peniophora lycii	*Tilia* dead branch, and rotten log
Phlebia rufa	on cut branch
Radulomyces confluens	*Aucuba* and *Populus* dead branches
Sistotrema oblongisporum	on rotten log
Stereum hirsutum	on dead branches and logs
Subulicystidium longisporum	on rotten log in wood pile
Trechispora nivea	on old stump
Trametes versicolor	on old logs and stump
Tubaria furfuracea	on soil and buried wood

Rust fungi

Coleosporium tussilaginis	*Tussilago farfara*
Melampsora epitea	*Salix caprea, S. cinerea* agg.
Melampsora larici-populina	*Populus nigra* hybrid
Phragmidium bulbosum	*Rubus fruticosus*
Phragmidium sanguisorbae	*Sanguisorba minor*
Phragmidium violaceum	*Rubus fruticosus*
Puccinia brachypodii	*Brachypodium sylvaticum*
Puccinia caricina var. *ribesii-pendulae*	*Carex pendula*
Puccinia coronata	*Glyceria maxima*
Puccinia magnusiana	*Phragmites australis*
Puccinia malvacearum	*Malva sylvestris*
Puccinia pulverulenta	*Epilobium hirsutum*
Puccinia punctata	*Galium verum*
Puccinia variabilis	*Taraxacum officinale*
Pucciniastrum agrimoniae	*Agrimonia eupatoria*
Pucciniastrum epilobii	*Epilobium* spp.
Uromyces geranii	*Geranium molle*
Uromyces pisi-sativi	*Lotus corniculatus*
Uromyces rumicis	*Rumex obtusifolius*

Smut fungus

Urocystis ranunculi	*Ranunculus repens*

Powdery mildews

Erysiphe artemisiae	*Artemisia vulgaris*
Erysiphe buhrii	*Silene dioica*
Erysiphe cichoracearum	*Aster* sp.; *Centaurea nigra*; *Eupatorium*; *Picris* sp.
Erysiphe convolvuli	*Calystegia* sp.; *Convolvulus arvensis*
Erysiphe galeopsidis	*Ballota nigra*; *Lamium album*
Erysiphe galii	*Galium verum*
Erysiphe heraclei	*Angelica sylvestris*
Erysiphe knautiae	*Scabiosa columbaria*
Erysiphe ranunculi	*Ranunculus repens*
Erysiphe sordida	*Plantago major*
Erysiphe trifolii	*Trifolium* sp.
Erysiphe ulmariae	*Filipendula ulmaria*
Erysiphe urticae	*Urtica dioica*
Microsphaera alphitioides	*Quercus robur*
Microsphaera berberidis	*Berberis* sp.
Microsphaera euonymi	*Euonymus* sp.

Microsphaera hedwigii	*Viburnum lantana*
Microsphaera penicillata	*Alnus glutinosa*
Microsphaera syringae	*Syringa vulgaris*
Microsphaera viburni	*Viburnum opulus*
Phyllactinia guttata	*Betula* sp.; *Corylus* sp.
Podosphaera clandestina	*Crataegus* sp.
Sawadaea bicornis	*Acer campestre*
Sphaerotheca aphanis	*Geum urbanum*
Sphaerotheca dipsacearum	*Dipsacus fullonum*
Sphaerotheca epilobii	*Epilobium* sp.
Sphaerotheca ferruginea	*Sanguisorba minor*
Sphaerotheca fugax	*Geranium* sp.
Sphaerotheca fusca	*Senecio* sp.; *Erigeron canadensis*
Sphaerotheca pannosa	*Prunus laurocerasus*
Sphaerotheca plantaginis	*Plantago lanceolata*
Uncinula adunca	*Populus nigra* hybrid; *Salix caprea*; *S. cinerea*
Uncinula flexuosa	*Aesculus hippocastanum*

Ascomycetes (other than powdery mildews)

Bisporella sulfurina	*Platanus* rotten wood
Cryptodiaporthe salicina	*Salix* sp. dead branch
Cryptosporella platanigera	*Platanus* × *hispanica* fallen branch
Cucurbitaria berberidis	*Berberis* sp. dead attached branch
Daldinia concentrica	*Fraxinus* stump
Dasyscyphella nivea	rotten wood
Diaporthe arctii	*Artemisia* sp. dead stem
Diatrype stigma	rotten branch
Diplocarpon rosae	*Rosa* sp. leaves
Drepanopeziza salicis	*Salix* sp.
Eutypa lata	decorticated wood of *Platanus*
Guignardia aesculi	*Aesculus* leaves
Guignardia philoprina	*Ilex aquifolium* dead leaves
Hormotheca robertiani	*Geranium robertianum* leaves
Hymenoscyphus caudatus	*Aesculus* fallen petioles
Hymenoscyphus scutulus	dead herbaceous stem
Hypoxylon fuscum	*Corylus* branches
Hypoxylon howeianum	*Corylus* branch
Hypoxylon rubiginosum	*Platanus* log
Lopadostoma gastrinum	dead branch
Nectria aquifolii	*Ilex* dead branches
Nectria cinnabarina	dead twigs
Nectria episphaeria	*Diatrype stigma*
Orbilia inflatula	dead wood of *Populus*
Phacidium multivalve	*Ilex* fallen leaves
Phaeosphaeria eustoma	*Phragmites australis* dead leaf
Physalospora sp.	*Heracleum* dead stem
Pseudopeziza trifolii	*Trifolium pratense* leaves
Rosellinia aquila	dead branches in wood pile
Taphrina populina	*Populus* leaves
Trochila ilicina	*Ilex* fallen leaves
Venturia maculiformis	*Epilobium hirsutum* leaves
Venturia rumicis	*Rumex* leaves
Xylaria hypoxylon	*Platanus* old stump; wood chips

Other microfungi

Ampelomyces quisqualis	powdery mildews
Ascochyta equiseti	*Equisetum arvense* dead stems
Cercospora malvarum	*Malva moschata* leaves
Cladosporium herbarum	*Populus* fallen leaf
Colletotrichum dematium	rotting *Populus* leaves and petioles
Cymadothea trifolii	*Trifolium pratense* leaves

Cytospora platani — *Platanus* fallen twigs
Dinemasporium cytosporoides — *Platanus* fallen twig
Erynia neoaphidis — aphid on *Euonymus* leaf
Eudarluca caricis — rust sori
Phoma hedericola — *Hedera* leaf spot
Phoma nebulosa — *Scrophularia* stem
Phomopsis epilobii — *Chamerion angustifolium* dead stems
Phyllachora dactylidis — *Dactylis* leaves
Ramularia filaris — *Picris* leaves
Ramularia pratensis — *Rumex acetosa* leaf
Ramularia rhabdospora — *Plantago lanceolata* leaves
Ramularia scrophulariae — *Scrophularia* leaf spots
Septoria leucanthemi — *Leucanthemum vulgare* leaf
Torula herbarum — rotten herbaceous stems
Trichoderma viride — old chestnut fence post

Slime moulds

Leocarpus fragilis — on dead wood
Trichia varia — on wood and bark

Lichens — see additional annotations ** and quadrats (*note for last report, Honey et al. 1998, species listed as *Scaletum* sp. and *Bacidia umbrinum* should read *Scoliciosporum umbrinum*)

Amandinea punctata
Arthopyrenia punctiformis
Bacidia delicata
Q *Caloplaca crenulatella*
Q *Candelariella aurella* f. *aurella*
Candelariella medians
Candelariella vitellina
** *Cladonia chlorophaea*
** *Cladonia ciliata*
** *Cladonia coniocraea*
** *Cladonia crispata*
** *Cladonia fimbriata*
** *Cladonia floerkeana*
** *Cladonia ramulosa*
Cyrtidula quercus
** *Hypogymnia physodes*
Q *Lecania erysibe*
Lecanora chlarotera
Lecanora conizaeoides
Q *Lecanora dispersa* agg.
Q *Lecanora muralis*
Q *Lecidella stigmatea*
** *Melanelia subaurifera*
Opegrapha vulgata
Parmelia mougeottii
** *Parmelia sulcata*
Peltigera hymenina
Q *Phaeophyscia orbicularis*
Q *Physcia adscendens*
Q *Physcia tenella*
Porina chlorotica
Porpidia tuberculosa
Q *Rinodina gennarii*
Scoliciosporum chlorococcum
Q *Scoliciosporum umbrinum*
Steinia geophana
Thelidium minutulum
Trapelia coarctata
Trapelia obtegens
Verrucaria muralis
Xanthoria candelaris
Q *Xanthoria parietina*
Xanthoria polycarpa

Bryophytes

Mosses and liverworts

Amblystegium serpens
Atrichum undulatum
Barbula convoluta
Barbula unguiculata
Brachythecium rutabulum
Bryum argenteum
Bryum bicolor
Bryum caespiticium
Bryum capillare
Bryum rubens
Calliergonella cuspidata
Campylopus introflexus
Cephalozia biscuspidata
Ceratodon purpureus
Dicranella heteromalla
Dicranum scoparium
Didymodon ferrugineus
Didymodon insulanus
Eurhynchium crassinervium
Eurhynchium hians
Eurhynchium praelongum
Eurhynchium speciosum
Fissidens taxifolius
Funaria hygrometrica
Grimmia pulvinata
Hypnum cupressiforme
Hypnum resupinatum
Leptobryum pyriforme
Leptodictyum riparium
Lophocolea bidentata
Lunularia cruciata
Marchantia polymorpha
Mnium hornum
Orthotrichum cf. *anomalum*
Orthotrichum diaphanum
Pellia epiphylla
Pohlia melanodon
Pohlia nutans
Polytrichum formosum
Polytrichum juniperinum
Tortula truncata
Racomitrium aciculare
Racomitrium canescens
Rhynchostegium confertum
Schistidium apocarpum
Schistidium rivulare
Scleropodium purum
Sphagnum papillosum
Syntrichia latifolia
Syntrichia ruralis
Thuidium tamariscinum
Tortula muralis
Tortula subulata
Weissia sp.

FAUNA

Invertebrates

Rotifers

Anuraeopsis fissa
Brachionus angularis
Cephalodella auriculata
Cephalodella gibba
Cephalodella ventripes
Collotheca ambigua
Collotheca ornata cornuta
Colurella adriatica
Colurella obtusa
Colurella uncinata
Dicranophorus forcipatus
Euchlanis deflexa
Euchlanis dilatata
Euchlanis incisa
Euchlanis triquetra
Floscularia melicerta
Floscularia ringens
Itura aurita
Keratella brevispina
Keratella quadrata f. *dispersa*
Lecane bulla
Lecane closterocerca
Lecane luna
Lecane lunaris
Lecane quadridentata
Lepadella ovalis
Lepadella patella patella
Lepadella patella similis
Lophocharis oxysternon
Monommata dentata
Mytilina bisulcata
Mytilina crassipes
Mytilina mucronata
Mytilina ventralis
Notholca acuminata
Platyias quadricornis
Pleurotrocha petromyzon
Polyarthra dolichoptera
Proales decipiens
Rotaria rotatoria
Squatinella mutica
Synchaeta oblonga
Synchaeta pectinata
Synchaeta tremula
Testudinella patina
Trichocerca carinata
Trichocerca dixon-nuttalli
Trichocerca porcellus
Trichocerca rattus
Trichotria pocillum
Trichotria tetractis

Tardigrada

Macrobiotus echinogenitus, Macrobiotus cf. *hufelandi, Hypsibius convergens, Ramazzottius oberhaeuseri.*

Turbellaria

Platyhelminthes: *Dugesia lugubris, Polycelis nigra.*

Crustacea (Branchiopoda and Anamopoda)

Chydorus sphaericus, Desmia longirostris, Daphnia hyalina, Daphnia longispina, Daphnia pulex, Graptoberis testudinaria, Scapholebris mucronata, Simocephalus vetulus.

Crustacea (Amphipoda)

Arcitalitrus dorrieni land hopper, *Asellus aquaticus, Asellus meridionalis, Bosmina longirostris, Chydorus sphaericus, Crangonyx pseudogracilis, Daphnia hyalina, Daphnia longispina, Graptoleberis tesudinaria, Scapholeberis mucronata, Simocephalus vetulus.*

Crustacea (Isopoda)

Armadillidium vulgare, Oniscus asellus, Philoscia muscorum, Porcellio dilatatus, Porcellio laevis, Porcellio scaber, Tracheliphus rathkei, Trichoniscoides albidus, Trichoniscus pusillus.

Annelida (Hirudinea)

Erpobdella testacea

Oligochaeta (earthworms)

Allolobophora caliginosa, Allolobophora chlorotica, Allolobophora rosea, Allolobophora longa, Lumbricus terrestris.

Acanthocephala (spiny-headed worms)

Filicollis anatis

Mollusca

Anisus vortex
Arion ater
Arion distinctus
Arion hortensis
Arion subfuscus
Bithynia leachii
Bithynia tentaculata
Candidula intersecta
Deroceras caruanae
Deroceras reticulatum
Discus rotundatus
Gyraulus albus
Helix aspersa
Lehmannia marginata
Lymnaea pereger
Lymnaea stagnalis
Milax budapestensis
Milax sowerbyi
Oxychilus draparnaudi
Physa acuta
Planorbarius corneus
Planorbis contortus
Planorbis planorbis
Trichia striolata
Vallonia costata
Valvata cristata

Arachnida (Acari, mites)

Pergamasus crassipes

Arachnida (Araneae, spiders)

Bathyphantes concolor
Clubiona brevipes
Clubiona compta
Diplostyla concolor
Dysdera crocata
Enoplognatha ovata
Erigone atra
Erigone dentipalpis
Lepthyphantes ericaeus
Lepthyphantes tenuis
Micrargus herbigradus
Pachygnatha degeeri
Pardosa pullata
Philodromus aureolus
Philodromus sp.
Tegenaria duellica
Theridion pallens
Theridion sp.
Theridion varians
Treridion melanurum
Xysticus cristatus

Diplopoda (millipedes)

Blaniulus guttulatus
Brachydesmus superus
Brachyiulus pusillus
Cylindroiulus caeruleocinctus
Ophyiulus pilosus
Polydesmus gallicus
Polydesmus inconstans
Polydesmus sp.
Tachypodoiulus niger

Insecta

Ephemeroptera

Cloeon dipterum

Odonata

Aeshna cyanea, Aeshna grandis, Aeshna mixta, Anax imperator, Coenagrion puella, Enallagma cyathigerum, Ischnura elegans, Sympetrum striolatum.

Hemiptera

Acanthosoma haemorrhoidale
Amphorophora rubi
Aphis fabae
Aulacorthum solani
Capitophorus similis
Gerris sp.
Hydrometra sp.
Hyperomyzus lactucae
Macrosiphoniella millifoliae
Macrosiphum euphorbiae
Macrosiphum rosae
Myzus ligustri
Myzus persicae
Notonecta sp.
Pemphigus bursarius
Pemphigus spyrothecae
Rhopalosiphum padi
Uroleucon sp.

Coleoptera

Acrotrichis fascicularis
Adalia bipunctata
Adalia decempunctata
Agonum albipes
Agonum dorsale
Aloconota gregaria
Amara convexiuscula
Amara ovata
Amischa analis
Amischa decipiens
Amphimallon solstitialis
Anaspis humeralis
Anaspis lurida
Anaspis maculata
Anaspis regimbarti
Anophthalmus duodecimstriatus
Anotylus rugosus
Anotylus sculpturatus
Anthrenocerus australis
Aphthona euphorbiae
Apion aeneum
Apion cerdo
Apion dichroum
Apion malvae
Apion radiolus
Apion semivittatum
Asaphidion curtum
Atheta aterrime
Atheta clientula
Atheta coriaria
Atheta crassicornis
Atheta fungi
Atheta laticollis
Atheta oblita
Atheta palustris
Atheta triangulum
Atheta xanthopus
Atomaria atricapilla
Atomaria borealis
Badister bipustulatus
Barypeithes pellucidus
Bembidion lampros
Bembidion obtusum
Bembidion tetracolum
Brachypterolus pulicarius
Bruchus rufimanus
Callicerus rigidicornis
Catops fuliginosus
Ceutorhynchus quadridens
Chaetocnema concinna
Chalcoides aurata
Cionus scrophulariae
Clytus arietis
Coccinella septempunctata
Corticarina gibbosa
Cryptophagus pallidus
Dermestes peruvianus
Dorytomus dejeani
Dorytomus melanophthalmus
Enicmus brevicornis
Exochomus quadripustulatus
Grammoptera ruficornis
Gymnetron pascuorum
Haliplus lineatocollis
Halyzia sedecimguttata
Harpalus affinis
Harpalus rubripes
Harpalus rufipes
Hydroglyphus pusillus

Hygrotus inaequalis
Laccophilus minutus
Lagria hirta
Langelandia anophthalma
Leiopus nebulosus
Leptura livida
Longitarsus flavicornis
Longitarsus luridus
Longitarsus melanocephalus
Longitarsus parvulus
Longitarsus succineus
Lyocyrtusa vittata
Mecinus pyraster
Megasternum obscurum
Meligethes aeneus
Meligethes carinulatus
Meligethes ruficornis
Metopsia retusa
Monotoma bicolor
Mordellistena acuticollis
Mordellistena variegata
Mycetoporus clavicornis
Nebria brevicollis
Notiophilus biguttatus
Notiophilus rufipes
Notiophilus substriatus
Ocypus ater
Ocypus olens
Oedemera lurida
Olibrus affinis
Olibrus flavicornis
Olibrus liquidus
Omalium caesum
Omalium italicum
Omalium rivulare
Otiorhynchus rugosostriatus
Otiorhynchus sulcatus
Philonthus cognatus
Philonthus fimetarius
Philonthus parcus
Philonthus varians
Phyllobius pyri
Phyllodecta laticollis
Phyllotreta diademata
Phyllotreta nigripes
Platyderus ruficollis
Propylea quattuordecimpunctata
Proteinus ovalis
Psylliodes chrysocephala
Psylliodes napi
Ptenidium pusillum
Pterostichus madidus
Pterostichus strenuus
Ptinus sexpunctatus
Ptomaphagus medius
Ptomaphagus subvillosus
Quedius curtipennis
Quedius humeralis
Quedius mesomelinus
Quedius tristis
Rhizophagus perforatus
Sericoderus lateralis
Simplocaria semistriata
Sitona hispidulus
Sitona lepidus
Sitona lineatus
Stegobium paniceum
Stenolophus mixtus
Stenus ossium
Stethorus punctillum
Stilbus testaceus
Syncalypta spinosa
Tachinus signatus
Tachyporus dispar
Tachyporus hypnorum
Tachyporus tersus
Thea vigintiduopunctata
Trechus quadristriatus
Trichiusa immigrata
Trichosirocalus troglodytes
Trixagus dermestoides
Tychius picirostris
Xantholinus linearis

Hymenoptera

Arge pagana, *Blennocampa phyllocolp*, *Bombus lucorum*, *Bombus terrestris*, *Lasius flavus*, *Lasius niger*, *Neuroterus quercusbaccarum*, *Rhadinoceraea micans*, *Vespula germanica*, *Vespula vulgaris*.

Diptera (aquatic)

Culiseta annulata, *Chaoborus crystalinus*, *Dixella* sp., *Oxycera* sp., Chironomidae.

Diptera (non-aquatic)

Amphorophora rubi
Anopheles claviger
Aulacorthum solani
Beris clavipes
Botanophila sp.
Bradysia albanensis
Bradysia sp.
Calliphora vicina
Campylomyza flavipes
Campylomyza sp.
Capitophorus similis
Chironomus dorsalis
Chloromyia formosa
Coenosia tigrina
Copromyza equina
Copromyza nigrina
Culex pipiens
Culicoides obsoletus
Culicoides sp.
Delia sp.
Dilophus febrilis
Diplonevra nitidula
Emmesomyia socia
Fannia canicularis
Fannia genualis
Fannia monilis
Fannia scalaris
Fannia sp.
Hebecnema nigra
Hebecnema vespertina
Helina reversio
Hydrotaea dentipes
Hydrotaea ignava
Hyperomyzus lactucae
Lauxaniidae
Limosina vitripennis
Lonchoptera lutea
Lucilia sericata
Lycoriella ingenua
Macrosiphoniella millifoliae
Megaselia aequalis
Megaselia badia
Megaselia brevicostalis
Megaselia dimidia
Megaselia latifemorata
Megaselia longicostalis
Megaselia sp.
Megaselia subtumida
Muscina levida
Muscina prolapsa
Muscina stabulans
Nemopoda nitidula
Neuroterus quercusbaccarum
Oligotrophini genus indet.
Opacifrons coxata
Oscinella pusilla
Parepidosis longinodis
Pegomya flavifrons
Pemphigus bursarius
Pemphigus spyrothecae
Phaonia fuscata
Phaonia halterata
Pollenia rudis
Psychoda albipennis
Psychoda sp.
Pullimosina moesta
Pullimosina pullula
Rhopalosiphum padi
Sarcophaga agnata
Sarcophaga carnaria
Sarcophaga carnaria species group
Sarcophaga roselli
Sarcophaga sp.
Sarcophaga subvicina
Scaptomyza pallida
Scathophaga lutaria
Sepsis punctum
Sicus ferrugineus
Smittia aterrima
Spelobia clunipes
Spelobia palmata
Suillia affinis
Suillia variegata
Sylvicola fenestralis
Tephrochalmys rufiventris
Trichocera annulata
Uroleucon sp.

Siphonaptera

Ceratophyllus gallinae gallinae

Orthoptera

Chorthippus brunneus, Chorthippus albomarginatus.

Lepidoptera

0006 ***Eriocrania subpurpurella*** 26.iv.2001
0014 ***Hepialus humuli*** ghost moth 25.vi.2001
0017 *Korscheltellus lupulinus* common swift (*Hepialus*)
0020 *Ectoedemia decentella* (*Etainia*)
0021 *Ectoedemia sericopeza* (*Etainia*)
** 0036a *Ectoedemia heringella* first trapped in 1996 but not identified until 2001. NEW TO BRITAIN (not as in Plant 2002)
0038 ***Ectoedemia subbimaculella*** 10.vii.1996 (but identified later)
0050 ***Stigmella aurella*** 4.iii.2002 (mine on bramble)
0070 ***Stigmella obliquella*** 1.vii.1999
0073 ***Stigmella trimaculella*** 7.vii.1998
0083 *Stigmella atricapitella*
0084 ***Stigmella ruficapitella*** 22.vii.1995 (but identified later)
* **0088** ***Stigmella samiatella*** 2.vii.1995 (but identified later)
0089 ***Stigmella basiguttella*** 6.vi.1996 (but identified later)
0111 ***Stigmella microtheriella*** 18.i.2001 (mine on *Corylus*)
0112 *Stigmella luteella*
0130 ***Incurvaria masculella*** 25.iv.2001 (by day)
0150 ***Adela reaumurella*** 21.iv.1998
0161 *Zeuzera pyrina* leopard moth
0169 *Zygaena filipendulae* six-spot burnet (listed as 'historic' but at least two were present on 20.vii.1998 and several on 19.vii.2000)
0185 ***Luffia ferchaultella*** 29.iii.2001 case found on lime tree
* **0200** ***Psychoides filicivora*** 20.iv.1998
0218 *Nemapogon variatella*
0231 ***Monopis imella*** 10.ix.1999
0236 *Tineola bisselliella* common clothes moth
0240 ***Tinea pellionella*** case-bearing clothes moth [found in Entom. Dept. 16.vi.1998, possibly from WLG]
0247 *Tinea trinotella*
0263 *Lyonetia clerkella* apple leaf miner
* **0266** ***Bucculatrix nigricomella*** 19.v.1999
0273 *Bucculatrix thoracella*
0274 *Bucculatrix ulmella*
* **0281** ***Caloptilia populetorum*** 30.vi.1998
0284 *Caloptilia rufipennella*
0285 ***Caloptilia azaleella*** 6.vi.1996
0286 *Caloptilia alchimiella*
0287 ***Caloptilia robustella*** 26.vii.2001
0288 *Caloptilia stigmatella*
0289 ***Caloptilia falconipennella*** 26.vii.2001
0293 ***Caloptilia syringella*** 12.v.2000
0294 *Aspilapteryx tringipennella*
0296 *Calybites phasianipennella* 16.vi.1999
0301 *Parornix betulae*
0313 ***Acrocercops brongniardella*** 29.vii.2002
0315 *Phyllonorycter harrisella*
0321 ***Phyllonorycter messaniella*** 28.vi.1995 (but identified later) bred 2.vii.1998 from mines on *Quercus robur*
0321a *Phyllonoryeter platani*
0329 ***Phyllonorycter spinicolella*** 1.ix.1999
0332 *Phyllonorycter leucographella* firethorn leaf miner 19.v.1998
0341 ***Phyllonorycter maestingella*** 30.vii.1999
0353 ***Phyllonorycter ulmifoliella*** 7.vii.2002
0361 *Phyllonorycter trifasciella*
0368 ***Phyllocnistis unipunctella*** 19.vi.2000
0374 *Synanthedon vespiformis* yellow-legged clearwing one found on a window-ledge in Entom. Dept. date not known
[0379 *Synanthedon myopaeformis* red-belted clearwing]
0385 ***Anthophila fabriciana*** nettle tap 16.vi.1999 (by day)
0396 *Glyphipterix fuscoviridella*
0409a ***Argyresthia trifasciata*** 19.v.1999
0411 *Argyresthia goedartella*
0414 *Argyresthia curvella*
0415 ***Argyresthia retinella*** 16.vi.1999
0417 *Argyresthia spinosella*
0420 *Argyresthia pruniella* cherry fruit moth
0421 *Argyresthia bonnetella* 26.vii.2001 not as in Plant 2002
0424 *Yponomeuta evonymella* bird-cherry ermine
0425 *Yponomeuta padella* orchard ermine
0426 *Yponomeuta malinellus* apple ermine
0427 *Yponomeuta cagnagella* spindle ermine
0428 *Yponomeuta rorrella* willow ermine
0435 *Zelleria hepariella*
0438 *Swammerdamia pyrella*
0442 ***Cedestis gysseleniella*** 4.vii.2001
0447 ***Roeslerstammia erxlebella*** 28.vii.1997
0449 ***Prays fraxinella*** 11.vi.1999
** **0449a** ***Prays citri*** 9.v.2000. NEW TO BRITAIN!
0450 *Scythropia crataegella* hawthorn moth

0455 *Ypsolopha scabrella*
0462 ***Ypsolopha sequella*** 6.viii.1999
0464 *Plutella xylostella* diamond-back moth
0465 ***Plutella porrectella*** 13.vi.1999
* 0483 ***Epermenia chaerophyllella*** 1.viii.2000
0490 *Coleophora lutipennella*
0493 *Coleophora serratella*
0494 *Coleophora coracipennella*
* 0510 ***Coleophora juncicolella*** 12.v.1998 larval case found, introduced with Dorset heath
0517 *Coleophora alcyonipennella (frischella* auctorum)
0518 *Coleophora mayrella*
0519 ***Coleophora deauratella*** 30.vi.1998
0522 ***Coleophora lineolea*** 26.viii.1999
0523 ***Coleophora hemerobiella*** 1.viii.2000
* 0541 ***Coleophora pyrrhulipennella*** 17.vii.1998, introduced with Dorset heath, 25.vi.1999 (bred?)
* 0552 *Coleophora lassella*
0553 ***Coleophora striatipennella*** 9.vi.1999
0556 ***Coleophora trochilella*** 5.vii.1999
* 0561 *Coleophora therinella* (omitted by Plant 2002 but without comment)
* 0562 ***Coleophora asteris*** 26.viii.1999
0563 *Coleophora argentula*
0568 *Coleophora versurella*
0577 *Coleophora artemisicolella*
0584 ***Coleophora alticolella*** 13.v.1997 (but identified later)
0587 *Coleophora caespititiella*
* 0588 *Coleophora salicorniae*
0607 ***Elachista canapennella***
0608 *Elachista rufocinerea* 4.v.1999
0610 ***Elachista argentella*** 18.v.1999
* 0632 *Cosmiotes consortella*
* 0638a *Denisia albimaculea*
0640 *Batia lunaris*
0642 *Crassa unitella (Batia)*
0644 *Borkhausenia fuscescens*
0647 *Hofmannophila pseudospretella* brown house-moth
0648 *Endrosis sarcitrella* white-shouldered house-moth
0649 *Esperia sulphurella*
* 0656 *Tachystola acroxantha*
0658 *Carcina quercana*
0663 *Diurnea fagella*
0695 *Agonopterix alstroemeriana*
0706 ***Agonopterix nervosa*** bred 29-31.v.1998 ex *Cytisus*
0724 ***Metzneria lappella*** 30.vi.1998
0726 ***Metzneria metzneriella*** 2.vii.1999
0729 *Isophrictis striatella*
0746 *Chrysoesthia drurella*
* 0748 *Ptocheuusa paupella*
0752 ***Aristotelia ericinella*** 26.vii.2000
0756 ***Parachrononistis albiceps*** 23.vi.1999
0757 *Recurvaria nanella*
0765 *Teleiodes vulgella*
0771 ***Teleiodes alburnella*** 4.vii.2001
0772 *Teleiodes fugitivella*
0774 *Teleiodes luculella*
0776 *Teleiopsis diffinis*
0779 *Bryotropha affinis*
0787 *Bryotropha terrella*
0789 *Bryotropha domestica*
* 0801 ***Gelechia scotinella*** 5.vii.1999
0801a ***Gelechia senticetella*** 19.vii.2000
0802a *Gelechia sororculella*
0807 *Gelechia turpella*
0814 ***Scrobipalpa ocellatella*** beet moth 6.viii.1999
0815 *Scrobipalpa nitentella*
0819 *Scrobipalpa costella*
0831 *Caryocolum proximum*
* 0840 ***Thiotricha subocellea*** 26.vii.2001
0843 ***Aproaerema anthyllidella*** 30.vii.1999
0853 *Anacampsis populella*
0859 ***Psoricoptera gibbosella*** 29.vii.2002
0868 ***Helcystogramma rufescens*** 26.viii.1999
0870 *Oegoconia quadripuncta*
0873 *Blastobasis lignea*
0874 *Blastobasis decolorella*
0878 *Batrachedra praeangusta*
0886 *Mompha ochraceella*
0888 ***Mompha propinquella*** 26.viii.1999
0891 ***Mompha sturnipennella*** 4.vii.2001
0892 *Mompha subbistrigella*
0893 *Mompha epilobiella*
* 0898 *Limnaecia phragmitella*
0903 *Chrysoclista linneella (Glyphipterix)*
0904 *Spuleria flavicaput*
0906 *Blastodacna atra* apple pith moth
0926 ***Phalonidia manniana*** pre 2001
* 0927 *Gynnidomorpha minimana (Phalonidia)*
* 0930 *Gynnidomorpha alismana (Phalonidia)*
0937 *Agapeta hamana*
0945 *Aethes cnicana*
0947 *Aethes smeathmanniana*
0964 ***Cochylis dubitana*** 25.viii.1999
0965 *Cochylis hybridella*
0968 *Cochylis nana*
0969 *Pandemis corylana* chequered fruit-tree tortrix
0970 *Pandemis cerasana* barred fruit-tree tortrix
0972 ***Pandemis heparana*** dark fruit-tree tortrix 19.vi.1999
0974 *Argyrotaenia ljungiana*
0977 *Archips podana* large fruit-tree tortrix
0979 ***Archips crataegana*** brown oak tortrix 19.vi.2000
0980 *Archips xylosteana* variegated golden tortrix
0983 ***Choristoneura hebenstreitella*** 19.vi.2000
0985 ***Cacoecimorpha pronubana*** carnation tortrix 6.viii.1999
0989 ***Aphelia paleana*** timothy tortrix 9.vi.1999
0994 *Clepsis consimilana*
0998 *Epiphyas postvittana* light brown apple moth

1000 *Ptycholoma lecheana*
1001 *Lozotaeniodes formosanus*
1010 *Ditula angustiorana* red-barred tortrix
1011 *Pseudargyrotoza conwagana*
1016 *Cnephasia longana* 22.vii.1997
1021 *Cnephasia asseclana* flax tortrix
1024 *Cnephasia incertana* light grey tortrix 4.vi.1998
1025 *Tortricodes alternella* 7.ii.2002 (in Entom. Dept. but probably from WLG)
1030 *Eana incanana* 19.vii.2000
1032 *Aleimma loeflingiana*
1033 *Tortrix viridana* green oak tortrix
1036 *Acleris forsskaleana*
1043 *Acleris aspersana*
1047 *Acleris schalleriana* 23.vi.1999
1053 *Acleris hastiana* 21.vi.2001
1054 *Acleris cristana*
1063 *Celypha striana* 9.vi.1999
1064 *Celypha rosacceana* 11.vi.1999
1076 *Celypha lacunana* (*Olethreutes*)
1083 *Hedya nubiferana* marbled orchard tortrix 13.vi.1996 (but identified later)
1097 *Endothenia gentianaeana*
1099 *Endothenia marginana* 1.ix.1999
1108 *Lobesia abscisana*
1113 *Eudemis profundana*
1133 *Epinotia bilunana*
1136 *Epinotia immundana* 28.iv.1999
1138 *Epinotia nisella*
1139 *Epinotia tenerana* nut bud moth 7.vii.1998
1150 *Epinotia abbreviana* 30.vi.1999
1156 *Epinotia solandriana* 26.vii.2001
1159 *Rhopobotia naevana* holly tortrix 17.vii.1998
1163 *Zeiraphera ratzeburgiana* 31.vii.2001
1165 *Zeiraphera isertana*
1167 *Gypsonoma aceriana*
1169 *Gypsonoma dealbana*
1170 *Gypsonoma oppressana* 12.vi.2000
1171 *Gypsonoma minutana*
1174 *Notocelia cynosbatella* (*Epiblema*)
1192 *Eucosma conterminana* 30.vi.1998
1200 *Eucosma hohenwartiana* 30.vi.1998
1201 *Eucosma cana* 11.vi.1999
1205 *Spilonota ocellana* bud moth
1207 *Clavigesta purdeyi* pine leaf-mining moth
1210 *Rhyacionia buoliana* pine shoot moth
1211 *Rhyacionia pinicolana* 19.vii.1995 (but identity confirmed later)
1212 *Rhyacionia pinivorana* spotted shoot moth misidentified in Honey et al. 1998 (actually 1211) but a specimen taken in 2003
1219 *Lathronympha strigana*
* **1225 *Pammene obscurana*** 9.v.2000
1233 *Pammene aurita* (*aurantiana* preoc.)
1234 *Pammene regiana*
1241 *Cydia compositella* 29.v.1998
1259 *Cydia fagiglandana* 21.vi.2001
1260 *Cydia splendana*
1261 *Cydia pomonella* codling moth
1273 *Dichrorampha petiverella* 26.vi.2001
1274 *Dichrorampha alpinana* 26.vii.2001
* **1276 *Dichrorampha plumbagana*** 16.v.2000
1279 *Dichrorampha acuminatana* 18.v.1998
* **1287 *Dichrorampha aeratana*** 21.vi.2001
* **1292 *Calamotropha paludella*** 8.vii.1999
1293 *Chrysoteuchia culmella*
1294 *Crambus pascuella*
1301 *Crambus lathoniellus*
1302 *Crambus perlella*
1303 *Agriphila selasella*
1304 *Agriphila straminella*
1305 *Agriphila tristella* misidentified in Honey et al. 1998 but actually new on 25.viii.1999
1306 *Agriphila inquinatella* 27.vii.2000
1309 *Agriphila geniculea*
1323 *Pediasia contaminella*
* **1328 *Schoenobius gigantella*** 8.vi.2000 'Nb'
1331 *Acentria ephemerella* water veneer
1333 *Scoparia pyralella* 1.vi.1998
1334a *Scoparia basistrigalis* 19.vii.2000
1336 *Eudonia pallida* 4.vii.2001
1338 *Dipleurina lacustrata*
1344 *Eudonia mercurella*
1345 *Elophila nymphaeata* brown china mark 25.viii.1999
1354 *Cataclysta lemnata* small china mark 29.vii.2002
1361 *Pyrausta aurata*
1375 *Ostrinia nubilalis* European corn borer 16.vi.1999
1376 *Eurrhypara hortulata* small magpie
1378 *Phlyctaenia coronata* 2.vii.1999
* 1380 *Phlyctaenia perlucidalis*
1392 *Udea olivalis* 8.vi.2000
1398 *Nomophila noctuella* rush veneer
1405 *Pleuroptya ruralis* mother of pearl
1413 *Hypsopygia costalis* gold triangle
1415 *Orthopygia glaucinalis*
1417 *Pyralis farinalis* meal moth
1424 *Endotricha flammealis*
1425 *Galleria mellonella* wax moth
1428 *Aphomia sociella* bee moth
1436 *Conobathra repandana* (*Acrobasis*)
1439 *Trachycera advenella* 23.viii.2000
1452 *Phycita roborella*
* **1454a *Dioryctria schuetzeella*** 25.vii.2002
1457 *Hypochalcia ahenella*
1470 *Euzophera pinguis*
1474 *Ephestia parasitella* 30.vi.2001
1479 *Plodia interpunctella* Indian meal moth 19.v.1998
1481 *Homoeosoma sinuella*
1484 *Phycitodes saxicola*
1497 *Amblyptilia acanthadactyla* 2.viii.2001
1504 *Platyptilia pallidactyla* 16.vi.1999
1524 *Emmelina monodactyla*
1526 *Thymelicus sylvestris* small skipper

1527 ***Thymelicus lineola*** Essex skipper 21.vii.2000
1531 *Ochlodes venata* large skipper
1546 *Gonepteryx rhamni* brimstone
1549 *Pieris brassicae* large white
1550 *Pieris rapae* small white
1551 *Pieris napi* green-veined white
1553 ***Anthocharis cardamines*** orange-tip April 2000
1557 ***Neozephyrus quercus*** purple hairstreak 5.viii.2000
1574 ***Polyommatus icaru*** common blue 8.vi.2000
1580 *Celastrina argiolus* holly blue
1590 *Vanessa atalanta* red admiral
1591 *Vanessa cardui* painted lady (*Cynthia*)
1593 *Aglais urticae* small tortoiseshell
1597 *Inachis io* peacock
1598 *Polygonia c-album* comma
1608 *Argynnis paphia* silver-washed fritillary 2.vii.2000 (unconfirmed record)
1614 *Pararge aegeria* speckled wood
1625 *Pyronia tithonus* gatekeeper
1626 *Maniola jurtina* meadow brown
1646 *Watsonalla binaria* oak hook-tip (*Drepana*)
1654 *Tethea ocularis* figure of eighty
1655 ***Tethea or*** poplar lutestring 8.vi.2000
1663 *Alsophila aescularia* March moth
1666 ***Geometra papilionaria*** large emerald pre 2000
1669 ***Hemithea aestivaria*** common emerald 1.vii.1999
1680 *Cyclophora punctaria* maiden's blush
1689 ***Scopula marginepunctata*** mullein wave 1.ix.1999
1699 *Idaea rusticata* least carpet
1705 *Idaea fuscovenosa* dwarf cream wave
1707 *Idaea seriata* small dusty wave
1709 ***Idaea subsericeata*** satin wave 10.ix.1999
1711 *Idaea trigeminata* treble brown spot
1713 *Idaea aversata* riband wave
1724 ***Xanthorhoe spadicearia*** red twin-spot carpet 9.v.2000
1728 *Xanthorhoe fluctuata* garden carpet
1732 *Scotopteryx chenopodiata* shaded broad-bar 18.vii.2002
1738 ***Epirrhoe alternata*** common carpet 27.iv.1998 introduced with Dorset heath?, 4.v.1999 (probably bred in WLG)
1742 *Camptogramma bilineata* yellow shell
1749 ***Pelurga comitata*** dark spinach 17.vii.1998
1760 *Chloroclysta siterata* red-green carpet
1764 *Chloroclysta truncata* common marbled carpet
1766 *Plemyria rubiginata* blue-bordered carpet
1795 *Epirrita dilutata* november moth
1799 ***Operophtera brumata*** winter moth 18.xii.2001
1811 *Eupithecia tenuiata* slender pug
1816 *Eupithecia linariata* toadflax pug
1817 ***Eupithecia pulchellata*** foxglove pug 12.vi.2000
1825 *Eupithecia centaureata* lime-speck pug
1827 *Eupithecia intricata* Freyer's pug
1834 *Eupithecia vulgata* common pug
1837 *Eupithecia subfuscata* grey pug
1846 *Eupithecia nanata* narrow-winged pug
1852 *Eupithecia abbreviata* brindled pug
1856 *Eupithecia lariciata* larch pug
1857 ***Eupithecia tantillaria*** dwarf pug 12.v.2000
1860 *Eupithecia rectangulata* green pug
1862 *Gymnoscelis rufifasciata* double-striped pug
1868 ***Aplocera efformata*** lesser treble-bar 6.vii.1998 on wall adjacent to garden but evaded capture and full identification
1876 *Asthena flammeolaria* small yellow wave
1893 *Macaria liturata* tawny barred-angle (*Semiothisa*)
1894 ***Chiasmia clathrata*** latticed heath 31.vii.2001
1902 *Petrophora chlorosata* brown silver-line
1905 ***Pachycnemia hippocastanaria*** horse chestnut 7.vii.1998 introduced with Dorset heath?
1906 *Opisthograptis luteolata* brimstone moth
1912 ***Ennomos quercinaria*** August thorn 12.vii.1999
1915 *Ennomos erosaria* September thorn
1921 *Crocallis elinguaria* scalloped oak
1922 ***Ourapteryx sambucaria*** swallow-tailed moth 26.vii.2001
1923 ***Colotois pennaria*** feathered thorn 21.x.1999
1926 *Apocheima pilosaria* pale brindled beauty
1927 *Lycia hirtaria* brindled beauty
1930 *Biston strataria* oak beauty
1931 *Biston betularia* peppered moth
1935 *Erranis defoliaria* mottled umber
1937 *Peribatodes rhomboidaria* willow beauty
1941 ***Alcis repandata*** mottled beauty 11.vi.2001
1954 ***Bupalus piniaria*** bordered white 19.vi.2000
1957 ***Lomographa bimaculata*** white-pinion spotted 8.vi.2000
1958 *Lomographa temerata* clouded silver
1961 ***Campaea margaritata*** light emerald 11.vi.1999
1979 *Mimas tiliae* lime hawk-moth
1981 *Laothoe populi* poplar hawk-moth
1984 *Macroglossum stellatarum* humming-bird hawk-moth
1991 *Deilephila elpenor* elephant hawk-moth
1994 ***Phalera bucephala*** buff-tip 16.v.2000
1998 ***Furcula bifida*** poplar kitten 12.v.2000
2000 *Notodonta dromedarius* iron prominent 1.viii.2001
2026 *Orgyia antiqua* vapourer
2029 *Euproctis chrysorrhoea* brown tail
2043 ***Eilema sororcula*** orange footman 19.v.1998

2050 ***Eilema lurideola*** 9.vii.1998
[2060 *Spilosoma lubricepeda* white ermine]
2063 ***Diaphora mendica*** muslin moth 16.v.2000
2064 *Phragmatobia fuliginosa* ruby tiger
2069 *Tyria jacobaeae cinnabar* listed in Honey et al. (1998) as 'historic' but one on 18.v.1998
2087 *Agrotis segetum* turnip moth
2088 *Agrotis clavis* heart and club
2089 *Agrotis exclamationis* heart and dart
2092 *Agrotis puta* shuttle shaped dart
2102 ***Ochropleura plecta*** flame shoulder 4.v.1999
2107 *Noctua pronuba* large yellow underwing
2109 *Noctua comes* lesser yellow underwing
2110 *Noctua fimbriata* broad-bordered yellow underwing
2111 *Noctua janthe* lesser broad-bordered yellow underwing
2112 ***Noctua interjecta*** least yellow underwing 30.viii.1995 but omitted from Honey et al. 1998
2118 ***Lycophotia porphyrea*** true lover's knot 19.vi.1998
2119 *Peridroma saucia* pearly underwing
2123 *Diarsia rubi* small square-spot
2126 *Xestia c-nigrum* setaceous Hebrew character
2134 *Xestia xanthographa* square-spot rustic
2142 *Anarta myrtilli* beautiful yellow underwing
2154 *Mamestra brassicae* cabbage moth
2157 *Lacanobia w-latinum* light brocade
2160 *Lacanobia oleracea* bright-line brown-eye
2164 *Hecatera bicolorata* broad-barred white (incorrectly under *Aetheria* in K & R 1996)
2166 *Hadena rivularis* campion
2173 *Hadena bicruris* lychnis
2182 *Orthosia cruda* small quaker
2187 *Orthosia cerasi* common quaker
2188 *Orthosia incerta* clouded drab
2190 *Orthosia gothica* Hebrew character
2192 ***Mythimna conigera*** brown-line bright-eye pre 2001
2193 *Mythimna ferrago* clay
2197 *Mythimna straminea (Treitschke)* southern wainscot 19.vi.2000
2198 *Mythimna impura* smoky wainscot
2199 *Mythimna pallens* common wainscot
2232 *Aporophyla nigra* black rustic
2240 *Lithophane leautieri* Blair's shoulder-knot
2243 *Xylocampa areola* early grey
2252 *Polymixis flavicincta* large ranunculus
2256 *Eupsilia transversa* the satellite
2258 *Conistra vaccinii* the chestnut
2262 *Agrochola circellaris* the brick
2263 *Agrochola lota* red-line quaker
2270 *Omphaloscelis lunosa* lunar underwing
2271 *Xanthia citrago* orange sallow 31.viii.2000
2272 *Xanthia aurago* barred sallow
2278 ***Acronicta megacephala*** poplar grey 18.v.1998
2279 *Acronicta aceris* sycamore
2284 *Acronicta psi* grey dagger
2289 *Acronicta rumicis* knot grass
2293 *Cryphia domestica* marbled beauty
2297 *Amphipyra pyramidea* copper underwing
2298 ***Amphipyra berbera*** Svensson's copper underwing pre 2000
2299 *Amphipyra tragopogonis* mouse moth
2300 *Mormo maura* old lady
2306 *Phlogophora meticulosa* angle shades
2312 *Ipimorpha subtusa* olive
2314 *Parastichtis ypsillon* dingy shears (*Enargia*)
2318 *Cosmia trapezina* dun-bar
2321 *Apamea monoglypha* dark arches
2322 ***Apamea lithoxylaea*** light arches 1.vii.1999
2330 *Apamea remissa* dusky brocade
2331 ***Apamea unanimis*** small clouded brindle 15.vi.2002
2336 *Apamea ophiogramma* double lobed
2337 *Oligia strigilis* marbled minor
2339 *Oligia latruncula* tawny marbled minor
2340 ***Oligia fasciuncula*** middle-barred minor 28.v.1998
2341 *Mesoligia furuncula* cloaked minor
2343 *Mesapamea secalis* common rustic
2343a *Mesapamea didyma* lesser common rustic
2353 ***Luperina testacea*** flounced rustic 25.viii.1999
2380 *Charanyca trigrammica* treble lines
2381 *Hoplodrina octogenaria* uncertain (*alsines*)
2384 *Hoplodrina ambigua* Vine's rustic
2387 *Caradrina morpheus* mottled rustic
2389 *Paradrina clavipalpis* pale mottled willow (*Caradrina*)
2410 ***Protodeltote pygarga*** marbled white spot 14.vi.2000
2423 ***Nycteola revayana*** oak nycteoline 30.vi.1998
2441 *Autographa gamma* silver Y
2450 ***Abrostola tripartita*** spectacle 15.vi.2002
2452 *Catocala nupta* red underwing
2469 *Scoliopteryx libatrix* herald
2474 *Rivula sericealis* straw dot
2477 ***Hypena proboscidalis*** snout 1.vii.1999

Trichoptera (caddis flies)

Agraylea multipunctata, Agraylea sexmaculata, Leptocera caenosa, Leptocera fontinalis, Leptocera nigra.

Vertebrates

Reptiles

Anguis fragilis	slow worm

Amphibians

Rana temporaria	common frog
Bufo bufo	common toad
Triturus vulgaris	smooth newt

Birds

Acrocephalus scirpaceus	Eurasian reed warbler	*Parus major*	great tit
Aegithalos caudatus	long-tailed tit	*Passer domesticus*	house sparrow
Anas platyrhynchos	mallard	*Phasianus colchicus*	common pheasant
Apus apus	common swift	*Phylloscopus collybita*	common chiffchaff
Ardea cinerea	grey heron	*Phylloscopus trochilus*	willow warbler
Carduelis carduelis	goldfinch	*Pica pica*	black-billed magpie
Carduelis chloris	greenfinch	*Prunella modularis*	dunnock
Columba palumbus	woodpigeon	*Psittacula krameri*	ring-necked parakeet
Columbia livia	feral rock dove	*Regulus regulus*	goldcrest
Corvus corone	carrion crow	*Scolopax rusticola*	Eurasian woodcock
Dendrocopus major	great spotted woodpecker	*Sturnus vulgaris*	European starling
Erithacus rubecula	European robin	*Sylvia atricapilla*	blackcap
Falco tinnunculus	kestrel	*Troglodytes troglodytes*	wren
Fringilla coelebs	chaffinch	*Turdus iliacus*	redwing
Gallinula chloropus	moorhen	*Turdus merula*	blackbird
Garrulus glandarius	Eurasian jay	*Turdus philomelos*	song thrush
Motacilla cinerea	grey wagtail	*Turdus pilaris*	fieldfare
Parus caeruleus	blue tit	*Turdus viscivorus*	mistle thrush

The following birds have been seen flying over the garden:

Accipiter nisus	sparrowhawk	*Larus argentatus*	herring gull
Anthus pratensis	meadow pipit	*Larus canus*	common gull
Apus apus	common swift	*Larus fuscus*	lesser black-backed gull
Branta canadensis	Canada goose	*Larus ridibundus*	black-headed gull
Buteo buteo	common buzzard	*Motacilla alba*	pied wagtail
Carduelis cannabina	common linnet	*Pernis apivorus*	European honey buzzard
Delichon urbica	house martin	*Phalacrocorax carbo*	great cormorant
Falco peregrinus	peregrine falcon	*Riparia riparia*	sand martin
Hirundo rustica	swallow		

Mammals

Apodemus sylvaticus	wood mouse	*Pipistrellus pygmaeus*	soprano bat (55 khz)
Microtus agrestis	field vole	*Rattus norvegicus*	rat
Mus musculus	house mouse	*Sciurus carolinensis*	grey squirrel
Myotis daubentoni	Daubenton's bat	*Vulpes vulpes*	red fox
Pipistrellus pipistrellus	pipistrelle bat		

Environmental factors

Water chemistry March 2003

A03 main pond pH 8.0
A08 upper pond pH 7.6
A03/A08 main/upper pond link pH 7.8
A03/A01 main/lower pond link pH 7.9
A01 lower pond pH 8.0
Underground water storage tank pH 8.0
'A00' Rainwater from rain precipitator pH 6.8

Air quality

See: www.defra.gov.uk and www.aeat.com/netcen/airqual/data/sitelon.html

Soil pH

Chalk downland pH 8.28, 1 September 2001.
Heathland pH 4.19, 1 September 2001.

Rock types

Waterfall (A10): Cotswolds, limestone, sandy limestone.
Dinosaur footprints (DF): Shelley limestone, Purbeck limestone, sandy limestone.
Fen (F03): basalt, slate (with quartz veins), quartzite, schist, gneiss.
Grassland edge (G04): sandstone, gneiss, ?dolerite, sandstone; carboniferous millstone grit.
Hedgerow, east (H02): limestone, gneiss, with granite vein, quartzite.
Hedgerow, west (H05): limestone, sandy limestone.
Scrub, east and west (S02): serpentine, quartzite conglomerate, ?dolerite, limestone, gneiss with granite pegmatite and muscovite mica, and with quartz and feldspar biotite mica, and with protruding feldspar.
Scrub (S03): red sandstone, granite, schist.
Woodland, brick circle (W08): sandstone, augen gneiss, feltsite, granite, garnet mica schist.

Conclusion

Monitoring techniques continue to improve and the information base widened to enable interpretation of results to include environmental data. A weather station has been set up this year to record temperature, wind speed and direction and amount of rainfall and humidity — this data will be added to the Wildlife Garden database.

Information for the general public is being interpreted from this store of data and will be available on the Wildlife Garden website. However monitoring is ongoing both as a management tool and as a means to track and assess the value to wildlife of the Museum's living exhibition of the British countryside.

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Ornithological records from Dulwich Woods, 1959–1960

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Abstract

Details are presented of selected species recorded in Dulwich Woods in 1959 and 1960. Brief comparison is made with recent records and some status changes are reported.

Introduction

Dulwich Woods are well known as a relic of the ancient woodlands that once covered the hills of south London (Lousley 1959, Jones 2002). Individual ornithological records have been published in the *London Bird Report* and surveys have been made recently (Ian Holt pers. comm.), but I am unaware of any published review of the ornithology of the woods. I made regular observations there from March 1959 to May 1960 (fifty-eight visits in all) and, although my records are not comprehensive, they seem worth putting on record as they pre-date the first atlas survey (Montier 1977) by nearly a decade.

The nature and extent of the woods at that period are fully described and mapped in Lousley (1959) and are not repeated here. Adopting the names mapped by him, my observations covered Lapse Wood, Ambrook Hill Wood and Peckarmann's Wood, together amounting to about 15 hectares. I did not have access to Low Cross Wood, nor to the land east of the disused railway (Sydenham Hill Wood on the map in Jones 1959). I also include observations from the then derelict garden of Wood Hall, adjoining Peckarmann's Wood and from the edge of the golf course abutting Lapse Wood.

Access to the woods was strictly controlled and the only person I ever saw there was the gamekeeper then employed, so human disturbance apart from the shooting of pigeons was minimal. So far as I am aware, the keeper was not raising game and did not seek to destroy corvids or raptors. Details of those species for which I made a written record at the time (but excluding those referring to birds seen only flying over) follow, together with information passed on to me by the keeper.

Mallard *Anas platyrhynchos*: a nest c/9 in oak leaves on the ground well within the wood on 24 April 1959.

Sparrowhawk *Accipiter nisus*: this was well known to the keeper, but I have only one probable record, so it was perhaps already in decline.

Kestrel *Falco tinnunculus*: a pair resident on the golf course.

Woodcock *Scolopax rusticola*: also well known to the keeper as a winter visitor. I saw singles in 1959 on 7 March and 1 November, but also, most surprisingly, on 26 July. The latter suggests the intriguing possibility that it could have summered or even attempted to breed.

Stock dove *Columba oenas*: resident, maximum six on 11 April 1959.

Wood pigeon *Columba palumbus*: maximum flock counts in autumn 1959 were 150 in September (but the keeper shot 300 in that month), 450 in October, 300 in November and 100 in December.

Cuckoo *Cuculus canorus*: heard calling regularly in both springs and presumed to have bred.

Little owl *Athene noctua*: one regularly on the golf course in 1960.

Tawny owl *Strix aluco*: one seen in April 1960. It was resident in the nearby district and presumably bred in the woods.

Woodpeckers: I have no record of **green woodpecker** *Picus viridis*, presumably because it was too familiar to note. **Great spotted** *Dendrocopus major* certainly bred and **lesser spotted** *D. minor* was resident, probably at least two pairs. These presumably bred as males were drumming in March and May 1960.

Redstart *Phoenicurus phoenicurus*: a juvenile migrant on 1 August 1959.

Mistle thrush *Turdus viscivorus*: a pair nested in 1960, raising one brood and building a second nest.

Warblers: the following were all present throughout the breeding season in 1959 and in spring 1960 until observations ceased. The numbers refer to the maximum number singing in either year. **Whitethroat** *Sylvia communis* (4), **blackcap** *S. atricapilla* (2), **chiffchaff** *Phylloscopus collybita* (6) and **willow warbler** *P. trochilus* (2). My recollection is that whitethroats were restricted mainly to the derelict gardens of Wood Hall.

Goldcrest *Regulus regulus*: my notes make frequent reference to one to three individuals, nearly all outside the breeding season, which suggests that I thought it sufficiently unusual to be worth noting. My only breeding season records concern singles on 3 and 15 April 1960, the latter singing.

Spotted flycatcher *Muscicapa striata*: I noted this species without particular comment throughout the 1959 breeding season and there were three on 21 May 1960. It presumably bred in the woods.

Marsh tit *Parus palustris*: one on 26 July 1959.

Willow tit *Parus montanus*: one on 21 March 1959.

Treecreeper *Certhia familiaris*: a pair nested in April 1960.

Magpie *Pica pica*: a pair nested in both years.

Starling *Sturnus vulgaris* and **house sparrow** *Passer domesticus*: I noted both species, in unspecified numbers, feeding on caterpillars in the woods on 21 May 1960.

Tree sparrow *Passer montanus*: two seen twice in winter 1959/60 and six on 10 January 1960. Three in Lapse Wood on 5 March 1960.

Chaffinch *Fringilla coelebs*: a small roost of 20+ in evergreen shrubs in the woods in January 1960.

Brambling *Fringilla montifringilla*: four on 21 February 1960 departed WNW. At least seven on 5 March and two on 3 April.

Goldfinch *Carduelis carduelis*: up to ten present in winter, mainly around the golf course. The only breeding season record is of one singing on 17 April 1960.

Linnet *Carduelis cannabina*: up to 15 around the golf course, but 50 on 26 September 1959. Four to five pairs there in May 1960.

Lesser redpoll *Carduelis flammea*: three records of singles outside the breeding season.

Crossbill *Loxia curvirostra*: five on 5 March 1959 flew off SW.

Hawfinch *Coccothraustes coccothraustes*: well known to the keeper, but I have only one uncertain record on 23 May 1959.

Discussion

These records, from a small, ancient and undisturbed woodland, only about 8 km from St Paul's Cathedral are mostly unremarkable, but they serve to document the presence there, over forty years ago, of typical woodland species in the midst of a densely populated urban area. In the discussion that follows, references to records between 1997 and 2003 refer to transect counts covering both Dulwich and Sydenham Hill Woods (Ian Holt pers. comm.).

The lesser spotted woodpecker was not mentioned from Dulwich by Homes et al. (1957), though it was present in the 1988–92 atlas survey. My records confirm Hewlett's (2002) supposition that it had been overlooked in the previous atlas survey. It has continued to be recorded until at least spring 2003. In contrast there have been no records of cuckoo since 1998–9 (the transect counts run from July to June, not the calendar year). Although my records of warblers are broadly consistent with both atlas surveys, there have been some changes since I made my observations. The only recent record of whitethroat is

of one on 16 May 1998 and, given that the most suitable habitat for it (the derelict garden of Wood Hall) has now gone, it seems that it is no longer breeding in the area. Up to twelve chiffchaffs have been counted in recent springs, though over a rather larger area than I covered, and compare with a peak of six in 1960, but there have been no spring records of willow warblers since three on 21 April 1998. On the other hand, there have been between ten and twenty-one blackcaps recorded in the more extensive transects in recent springs compared with my maximum count of two singing males, while about five pairs were thought to be breeding in 1998. An additional potential breeding species has also appeared in the form of two singing male firecrests *Regulus ignicapillus* in Sydenham Hill Wood in 1989 (Hewlett 2002) though there have been no such records since. Spotted flycatchers, common in the woods forty years ago, have not been known to breed there since before 1993. Neither atlas survey recorded willow tit, but as I saw this species only once, it may have been a straggler. Marsh tit had gone by the time of the second atlas survey and there have been no contemporary records of either that species or willow tit.

While magpies had attempted to breed in Dulwich, presumably in the woods, in 1938–9 (Homes et al. 1957) and were noted in adjacent tetrads in the 1968–72 atlas survey, the presence of a nesting pair in 1959 was a comparatively unusual occurrence compared with its then status in the surrounding residential areas (pers. obs.). It is now a common species in the woods, with, on average, between six and nine being counted on standard transect counts. It seems that the sight of starlings and house sparrows invading the woods in numbers in May to feed on caterpillars is now a thing of the past, for transect counts of starlings have not recently exceeded fifty and were no more than ten in 2001-02, while house sparrows averaged only one in 2000–1 since when there have been no records from the woods. The hawfinch was known from Dulwich in the 1940s (Homes et al. 1957) and continued to be present at the time of the 1988–92 atlas survey, but there have apparently been no records since two in April 1988 so it seems that it may now be lost as a breeding species in the woods. Amongst non-breeding birds, the regular presence of woodcock in winter has not, so far as I am aware, previously been reported from Dulwich, though Homes et al. (1957) noted that it was almost certainly overlooked in the built-up areas. It continues to occur in the woods as one was seen in 1998–9. The summer record reported here appears unprecedented.

Acknowledgements

I remain grateful to the then governors of Alleyn's College of God's Gift who very kindly allowed me access to the woods. Ian Holt kindly made available recent counts carried out in Dulwich and Sydenham Hill Woods for the London Wildlife Trust and I am grateful to Jan Hewlett for arranging this. Ian Holt also kindly commented on a draft of this note.

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Book review

A field guide to the reptiles and amphibians of Britain and Europe. E. Nicholas Arnold. Illustrated by Denys W. Ovenden. HarperCollins Publishers, London. Second edition. 2002. 288 pp. 49 colour plates, numerous line drawings and 192 distribution maps. £19.99 hardback. ISBN 0 00 219964 5.

After well over two decades since the publication in 1978 of the original book, this standard field guide was certainly in need of a make-over and general update. The new edition makes interesting reading and contains many more species than before. This is largely due to the taxonomic splitting of species that has occurred during the late twentieth century but also covers some species included for the first time because of the extended geographical range of the guide.

The English names have also been changed, although I think most people in Britain will continue to refer to great crested newts rather than the latest name of northern crested newt. This debate about splitting and English names seems to have a familiar parallel in the bird world a few years ago.

It is, therefore, tempting to compare this revised field guide with the numerous advances in bird guide presentation that has occurred over a similar period. Whilst bird field guides have developed in leaps and bounds, this new edition does still have a rather old fashioned feeling to it, although the excellent illustrations are what you would expect from this established artist and the text has also largely been brought up to date. The plates, however, are still located in a central section in the middle of the species text, with the maps at the back of the book, making quick reference more time consuming in the field.

Ultimately, of course, the key test for any book reviewer is to decide whether to recommend it to readers for purchase. In this regard it is undoubtedly the best guide available on the market and if you are working or holidaying on the Continent then it deserves a place on your bookshelf and in your luggage. If your natural history activity is confined to Britain, however, then it probably will not be on your Christmas wish list since our few British species will probably render it into the class of a luxury item.

CLIVE HERBERT

Introduction and establishment of the pikeperch *Stizostedion lucioperca* (L.) in Stanborough Lake (Hertfordshire) and its dispersal in the Thames catchment

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KEYWORDS: zander, ecomorphology, non-native, meristics, fecundity, vertebrae back-calculated growth, River Lee, non-indigenous, exotic, alien, angling.

Abstract

European pikeperch (or zander) *Stizostedion lucioperca* (L.) were illegally introduced into Stanborough Lake (Hertfordshire, England) in 1985. We examined fisheries survey data, anglers' reports and Environment Agency records to summarize the events surrounding the species' introduction, its spread into the adjacent River Lee and down the river into the River Thames catchment. We also studied the species' environmental biology (morphology, growth, reproduction) and establishment success in the lake. Our results are examined in light of available data from the UK and Continental Europe, and implications of the species' invasion are discussed.

Introduction

There was a predilection across Europe in the nineteenth and early twentieth centuries to attempt the acclimatization of foreign species (e.g. Künstler 1908, Vivier 1951), which in the UK manifested itself in the so-called 'acclimatization societies' (Lever 1977). As a result, numerous non-native freshwater fishes were introduced to the UK with no regard to the potential risks and impacts to UK flora and fauna of introducing an exotic species (Manchester and Bullock 2000). Indeed, such attempts continued until relatively recently (e.g. Stott

1977). One of the first species to give rise to notable ecological concern was the European pikeperch *Stizostedion lucioperca*[1] (Linnaeus, 1758), also widely known in the UK by its German name, zander, perhaps because the first specimens introduced to the UK were imported from Germany. The first recorded English introduction was in January 1878, when the ninth Duke of Bedford released twenty-three pikeperch, each of about 1 kg and originating from Bothkamper Lake, Schleswig-Holstein, into two lakes at Woburn Estates (Sachs 1878). The reason for the species' introduction was probably as a highly appreciated culinary dish (Sachs 1878, Maitland and Campbell 1992), which may have been behind the numerous attempts, many of them unsuccessful, to import and breed the species (Lever 1977). Also mentioned by Lever (1977) was another poorly documented introduction in 1910 to Woburn that was apparently made from an unreported locality. Following these introductions, pikeperch were translocated from Woburn to local waters. Populations were established in a number of still waters including Claydon lakes near Steeple Claydon, Buckinghamshire. All subsequent introductions of pikeperch are believed to have derived from the original Woburn stock (Fickling 1980).

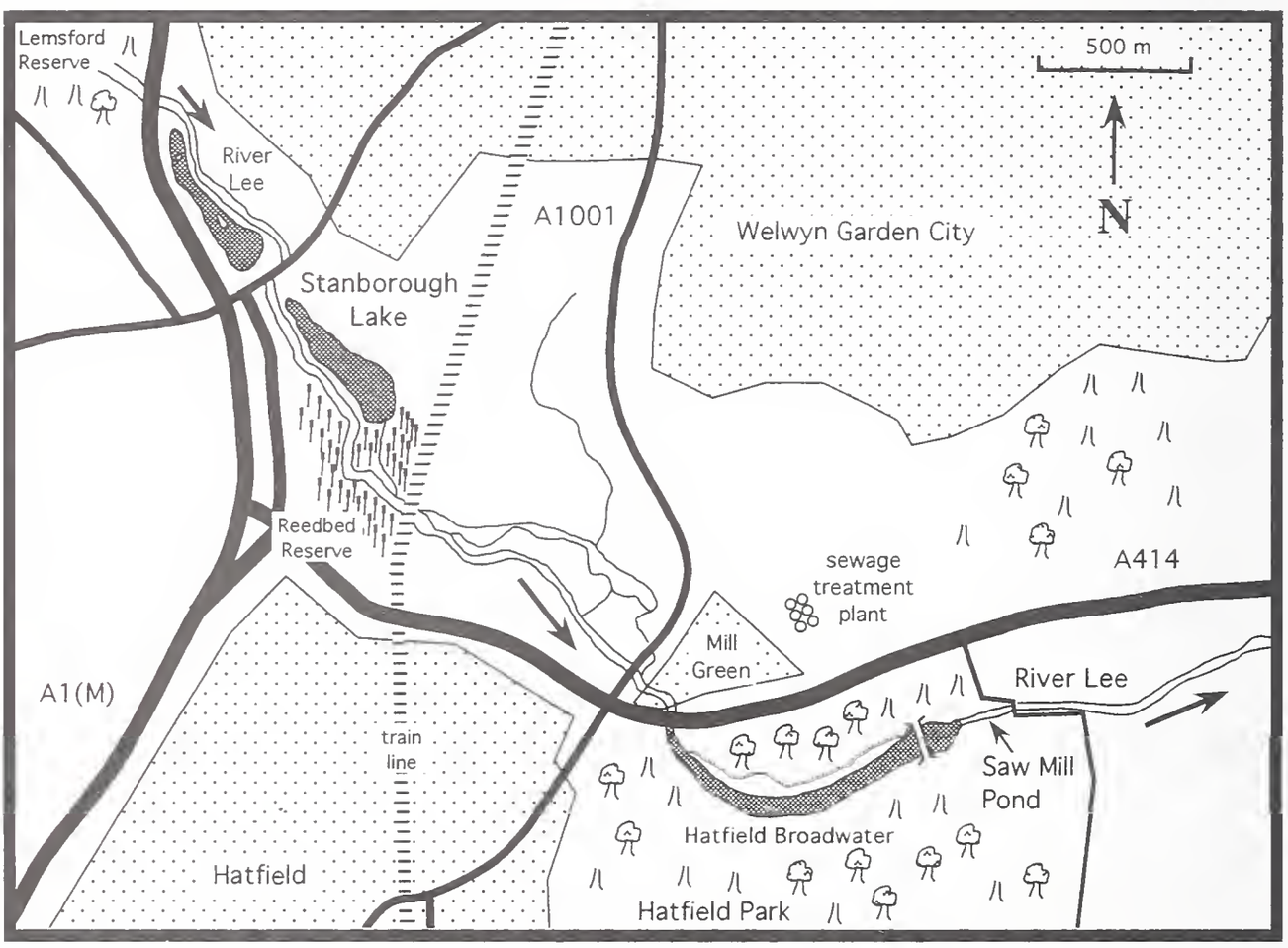

FIGURE 1. Map of Stanborough Lake and adjacent River Lee at Welwyn Garden City and Hatfield, Hertfordshire, England.

Translocation of pikeperch to the River Great Ouse system occurred in 1960, when mature pikeperch were taken from Woburn to stock ponds of the then Great Ouse River Authority. The fish bred successfully in the ponds and ninety-seven individuals from this stock were subsequently released into the Great Ouse Relief Channel at Stowbridge in March 1963 (Wheeler 1974). The species subsequently spread throughout the Fenland drain system (Wheeler 1974, Cawkwell and McAngus 1976). The observed mechanisms of pikeperch invasion in terms of distribution and population growth (Hickley 1986) suggest that the species can rapidly become established in a suitable habitat, but further colonization of new reaches of a watercourse (if unaided by man) can be slow.

[1]Reaction to Kottelat (1997) regarding the replacement of *Stizostedion* by *Sander* has varied, with many post-2000 papers retaining *Stizostedion*.

However, pikeperch are capable of migrating considerable distances (Fickling and Lee 1985, Koed et al. 2002), suggesting that they can move to new areas relatively quickly, but the presence of locks may slow this process (Smith and Briggs 1999). Wheeler and Maitland's (1993) prediction that pikeperch would find its way via anglers into other river systems appears to have been proved correct, following anglers' reports of pikeperch captures in the River Severn and in the River Lee (or Lea) during the early 1970s (Wheeler 1974), and recent (October 2003) unconfirmed reports of small pikeperch (15–20 cm) in the Welsh Dee at Farndon and Crook of Dee. To our knowledge, there were no further reports of pikeperch in the River Lee until the late 1980s, following the release in 1983 of ten specimens into Stanborough Lake (Figure 1), a restored gravel pit that lies adjacent to the River Lee between Hatfield and Welwyn Garden City, Hertfordshire (National Grid Reference TL230108).

Studies of the pikeperch since its introduction to the UK have concentrated primarily on its perceived impact on native fish stocks (e.g. Linfield and Rickards 1979, Fickling and Lee 1983, Smith and Eaton 1995), but the evidence for negative impacts on cyprinid stocks is equivocal (Smith et al. 1998). Other aspects of pikeperch biology, such as their morphometrics, have received little or no study in the UK, and the present investigation is the first on the environmental biology of pikeperch within the Thames catchment. The aim of our investigation was to assess the introduction, fecundity, growth and morphology of the pikeperch in Stanborough Lake as a means of understanding more of the species' biology related to invasion. We compare our results with available data from the UK, in particular original data from the pikeperch population in Ash Drain of the Great Ouse fenland area, and elsewhere in Europe.

Study site, material and methods

Stanborough Lake, Hertfordshire (National Grid Reference TL230108), is a man-made lake of 4.4 hectares that was first excavated in 1970 (Figure 1). The lake was initially stocked with tench *Tinca tinca* L., common bream *Abramis brama* L., pike *Esox lucius* L. and roach *Rutilus rutilus* L. However, common carp *Cyprinus carpio* L., roach *Rutilus rutilus* L., dace *Leuciscus leuciscus* L., rudd *Scardinius erythropthalmus* (L.) and Eurasian perch *Perca fluviatilis* L. have subsequently been observed during angling and fisheries surveys; these species were either stocked in or entered the lake from the adjacent river during extreme flood events. Within ten years of its construction, the lake had good water quality and a well-developed community of aquatic plants, which had become an impediment to water sports. To reduce the aquatic vegetation, the lake was treated with dichlobenil (Casoron) herbicide (2,6-dichlorobenzonitrile), but this exterminated all aquatic macrophytes. The absence of natural refuges and the presence of sufficient numbers of efficient zooplanktivorous fishes combined to give what is now viewed as a typical response — a reduction in zooplankton size and number (Moss et al. 1996), which promoted eutrophication processes (in particular algal blooms) and gave rise to the lake's present 'pea soup' appearance.

Stanborough Lake is situated directly in the flood plain of the River Lee, with a narrow strip of land (4 to 5 m) separating it from the river along the lake's western side (Figure 1). As a consequence, the lake undoubtedly receives both ground and river water inputs. At its downstream end, the lake's outflow passes through a concrete pipe, which is fitted with a simple, unguarded wooden plank weir, directly into the river system via a marshland (a reed-bed reserve managed by Hertfordshire County Council).

Information on the introduction and establishment of pikeperch into Stanborough Lake was compiled from bibliographic sources and various data bases (Table 1). Live specimens of pikeperch were collected by seine netting, electrofishing (Millstream D.C. generator-powered apparatus) from Stanborough Lake as well as by rod and line on 23 February and 10 March 1993. During the same period, additional specimens were acquired from the

Environment Agency–Anglian Region (formerly National Rivers Authority) immediately after a culling exercise on Ash Drain (River Great Ouse system) and a few young-of-the-year juvenile specimens were collected from Hatfield Park Broadwater (Grid Ref. TL245095), which is an on-line artificial river reservoir that lies about 1 km downstream of Stanborough Lake (Figure 1). Ash Drain (Great Ouse Middle Level) is located in Cambridgeshire, near Chatteris and Ramsey, and is a typical example of drainage channels in the Fenland area, 10–12 m wide, 1.15 m deep and of trapezoidal channel shape with peat and clay substrate. The water in the 2-km long drain is generally murky, has high conductivity (1,000 $\mu S.cm^{-1}$) and prominent vegetation (*Phragmites australis*) at the margins.

Laboratory analyses

The specimens (59 in total) were kept alive in aerated basins and within a week were measured for 29 morphological (mensural) characters (Table 2) using a vernier calliper to the nearest 0.05 mm (as per Holčík 1989). The 29 mensural characters were expressed as a percentage of standard length (SL), which is considered more susceptible to variability than other body lengths but permits comparison with published data (Goubier 1969/70). Fifteen of the characters were also expressed in percentage of head length (Table 3). Five meristic characters were also counted (Table 4). After morphological measurement, each specimen was dissected to determine sex. The gonads were weighed to the nearest 0.1 g. From five females with mature oocytes, thirty eggs from each part of the gonad (proximal, median and distal) were extracted, weighed, the number of eggs counted and the diameter measured to 0.01 mm accuracy using a microscope fitted with micrometer. Gonadosomatic index (GSI) was calculated: GSI (in %) = (w_g/w_t)*100, where w_g = total gonad weight (in g) and w_t is total weight (in g) of the fish. Absolute fecundity (F_a) was estimated using the gravimetric method ($F_a = (w_g/w_s)$ * n_s, where w_s = sub-sample weight (g), n_s = number of eggs in the sub-sample), followed by the relative fecundity (F_r) of individuals ($F_r = F_a/w_t$).

For age and growth determination, five vertebrae were removed from the region directly behind the skull and five scales were removed from an area below the lateral line of the fish. The vertebrae were labelled, oven dried for two to three days and cleaned of residual cartilage. Total (vertical) radius and distances between annuli (from the centre) on the vertebrae were measured using a 20× binocular microscope fitted with a micrometer graticule. The scales were cleaned with water and dried between microscope slides for analysis; these were used when difficulties were encountered in reading the first annulus on the corresponding vertebrae. The vertebrae and scales were reanalysed 'blind' a month later to ensure calibration accuracy, and the annuli on the vertebrae were found to be much more distinct. For back-calculation of growth, simple linear equations were elaborated to express the relationship between FL and vertebra total radius (FL = 76.40*radius + 103.86, r^2 = 0.852, F = 259.7, df = 44, P = 0.0001). The SL equivalent was: SL = 70.85*radius + 83.26, r^2 = 0.865, df = 44, P = 0.0001). For thirteen additional specimens, captured by rod and line during the same period, we were able to obtain scale samples, weights and fork lengths only, and these were included in the back-calculation estimates following the same process. Generalized condition (sensu Pitcher and Hart 1992) was assessed using the slope coefficient 'b' for the logarithmic relationship between SL and body weight, with FL vs. weight also given for comparative purposes. Age specific condition (plumpness) was evaluated using Fulton's index as per Mills and Eloranta (1985): $K=W10^5 \cdot FL^{-3}$, where W is the wet weight in g.

Results and discussion

Introduction and establishment

Wheeler's (1974) report of a pikeperch in the River Lee, perhaps an illegal transfer following a pikeperch introduction to an enclosed still water near the

Lee in Essex (S. Colclough, pers. comm.), was to our knowledge the last until the mid 1980s (Table 1). Elsewhere in the Thames basin (N. Foulkes, pers. comm.), pikeperch were stocked legally in 1974 into Old Bury Hill Lake, which feeds into Pippbrook; adult and fingerling pikeperch were found downstream in Milton Court Lakes but not in Dorking Mill Pond further downstream, with occasional pikeperch caught during the 1980s in the River Mole below its confluence with Pippbrook. Of the ten pikeperch of 1.3–2.3 kg translocated from the Great Ouse Relief channel in October/November 1985 to Stanborough Lake, six are thought to have survived — four were found dead in the lake soon after their release, presumably due to the stress of transport in dustbins without a supply of oxygen. This intentional translocation was carried out by two disgruntled anglers who were unhappy with a ban (on pike fishing in the lake) imposed by their angling club (pers. comm.). Movement from Stanborough to the Lee is possible via the Lake's outflow, and pikeperch caught in the lower Thames in 1987 (Table 1) may originate from Stanborough, or from downstream movement of fish from the R. Mole, or from an apparent illegal introduction directly into the Thames in 1984–1985, when the occasional large, tatty specimens were taken in fyke nets (N. Foulkes, pers. comm.). The capture of small pikeperch in Stanborough in the summer of 1988 suggests the species began reproducing in the summer immediately following their introduction. Some pikeperch were also released into the adjacent River Lee by anglers who refused to kill or to return the fish to the lake (pers. comm.).

Following a stock assessment in May 1991, a five-day cull of pikeperch in March 1992 (two-passage seine netting of stop-netted open water areas, electrofishing of the margins) yielded about 300 pikeperch of various weights along with only 59 kg of roach, common bream and rudd (larger specimens, e.g. bream > 0.68 kg, showed signs of bite marks). The cull was incomplete, due in part to poor weather conditions. Pikeperch continue to be captured from the Lake by rod and line and some of these have been released into the River Lee by anglers (pers. comm.). Downstream movement of pikeperch was evinced by captures in December 1992 and January 1993 in the Lee at and below Hertford. In the Lee at Mill Green, downstream of Stanborough (Figure 1), electrofishing surveys yielded small to moderate-sized specimens (Table 1). Small pikeperch found downstream at Sawmill Pool in 1995 could indicate reproduction in Hatfield Broadwater in 1993. During 1996–1997, pikeperch were captured on the Lower Lee at Stonebridge Lock, and subsequently became an occasional feature in anglers' catches along the lower Lee and Thames (Table 1).

Somatic growth and morphology

Of the fifty-nine pikeperch obtained for examination, twenty-five were collected from Stanborough Lake, twenty-nine from Ash Drain and five from Hatfield Broadwater. Forty-six specimens were examined for back-calculation of growth: twenty males, eighteen females, and eight undifferentiated juveniles. Specimens from Stanborough Lake were aged 1+ to 8+ and from Ash Drain 2+ to 7+. No sexual dimorphism in FL was observed, but differences between sites (Figure 2B) were observed for fish aged 3+ (unpaired $t = 2.123$, $df = 34$, $P = 0.041$) and 4+ ($t = 2.064$, $df = 24$, $P = 0.05$) only and single or few specimens were obtained for older age classes. All subsequent somatic growth indices are for all sites and sexes combined. The growth curves are similar to other UK and Continental populations (Figure 2C).

The slope of the relationship between FL and TL for Stanborough/Ash pikeperch was similar to that reported by Goubier (1969/70) in France ($FL = 0.96TL - 5.2$), though our intercept was closer to the origin (Table 5). Material from the Czech Republic for young-of-the-year pikeperch gave similar slopes to ours with respect to FL vs TL but not TL vs SL. The TL to SL ratio of our specimens averaged 1.199 ($n = 59$), which is very similar to that reported for 0+ and 1+ pikeperch in the Czech Republic ($TL/SL = 1.18$, Závěta & Velebný 1989;

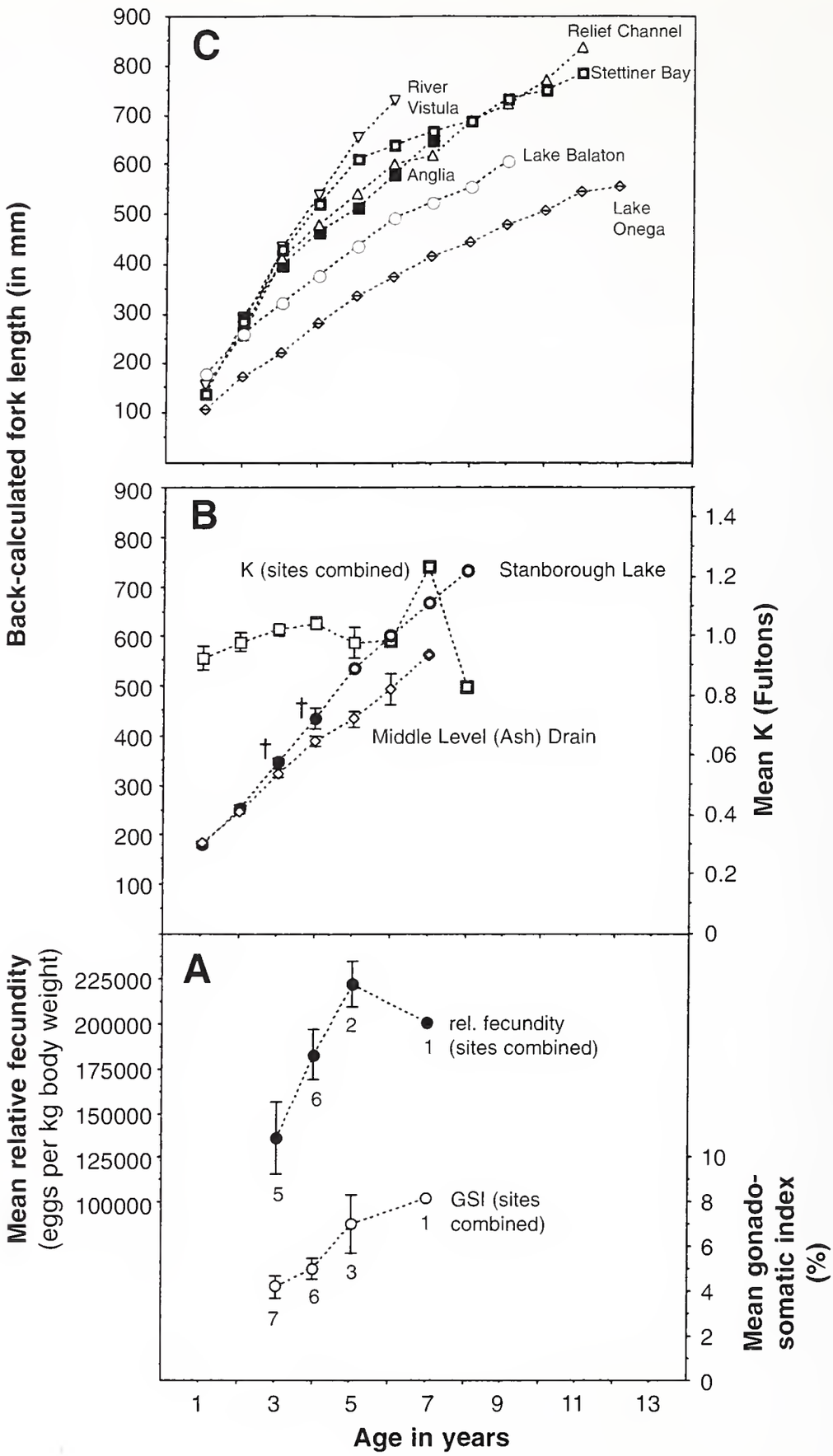

FIGURE 2. For pikeperch *Stizostedion lucioperca* from Stanborough Lake (Hertfordshire) and the Middle Level (Ash) Drain (Cambridgeshire): A) Age specific gonado-somatic index (GSI in %) and relative fecundity (eggs·kg^{-1} body weight, with number of samples given below the values), B) back-calculated growth (thick lined circles, squares and diamonds indicate single specimens; '†' indicates a significantly different size at age, Student's unpaired t-test, $P \leq 0.05$), and C) back-calculated growth from bibliographic sources: Stettiner Bay (Neuhaus 1934); Lake Onega (Kuznetzova 1955); Lake Balaton (Biro 1970); River Vistula (Nagiec 1977); Relief Channel and other East Anglian drains of the River Great Ouse (Fickling 1980).

TL/SL = 1.25, Prokeš 1990). The length-to-weight relationships appear to fall into the same magnitude except the Orlík Reservoir (Table 5), where only 0+ and 1+ specimens were examined and their faster relative growth (generalized condition) is apparent from the higher slope value ('a'). In terms of age specific condition (Fulton's index), values were near 1.0 except the lone specimen at age 7 (Figure 2B).

Meristically, the Stanborough/Ash pikeperch were indistinguishable and showed a range of values similar to those reported for populations in central Europe (Oliva and Safranek 1962), except that rather smaller counts were observed in the number of bifurcated rays in the second dorsal fin and higher counts in the number of anal fin spines (Table 4). The mean numbers of fin rays/spines from the English specimens is similar to those from four sections of the Yugoslav Danube (derived from Krpo-Ćetković and Stamenković 1996), except for a lower number of spines in the second dorsal fin, which appears to be linked to the primarily lotic origin of the Danubian specimens. The low counts in our material for D2 soft rays resulted mainly from fin damage due to predatory attacks or other deformations, whereas the higher A-fin spine counts may be a biogeographical phenomenon. Unfortunately, this biogeographical aspect is difficult to assess from published information, as the tabular data (repeated here in Table 4) provided by Oliva and Safranek (1962) is inconsistent with their text. Nonetheless, there does appear to be an increase in the number of anal fin spines from east to west.

There is little difference in the mean values for morphological characters between English pikeperch (Tables 2 and 3) and those of the Middle Danube (Krpo-Ćetković and Stamenković 1996). The only possible exception is the depth of the second dorsal fin, which appears to be smaller in the English specimens, coinciding with a slightly lower mean number of dorsal fin rays (Table 4). Both the English and Danube zander appear to have proportionately longer heads, greater preorbital distances, larger eye diameters and shallower body depths than those from studies of other Continental populations reviewed by Marshall (1977).

Reproduction

Four of twenty-one female pikeperch (nine from Stanborough, twelve from Ash Drain) were immature, being <300 mm SL and containing small ovaries with no yolked eggs; these specimens were ignored in subsequent analyses. Considerable variation in the age at which pikeperch reach maturity is shown by separate Continental European populations of pikeperch (Bastl 1970, Deedler and Willemsen 1964, Nagiec 1977, Zivkov and Petrova 1993). The smallest female pikeperch containing yolked eggs in our samples was 378 mm FL (age 3, weight = 552.9 g) and the smallest male with testes was 350 mm FL (age 2, weight = 424.1 g); the information for females generally agrees with Fickling (1980), who observed sexually mature female pikeperch of 340 mm FL. Freidenfelt (1922) reported female pikeperch maturity to be reached at 42-44 cm, though the length (fork, standard, total) is not specified. Relative fecundity (eggs per kg body weight) was significantly lower (unpaired $t = -3.037$, $df = 19$, $P = 0.0068$) in Stanborough (mean = 113 130.4 eggs·kg^{-1}, SE = 19824.7, n = 11) than in Ash Drain specimens (mean = 187 956.9 eggs·kg^{-1}, SE = 13 811.7, n = 10). These values are lower ($F = 9.995$, $df = 25$, $P = 0.0002$) than Oxford canal populations (mean = 208 141.4 eggs·kg^{-1}, SE = 25 627.8, n = 4) but higher than Great Ouse Middle-levels populations (mean = 83 277.5 eggs·kg^{-1}, SE = 10 736.4, n = 6) reported by Fickling (1980). Values for English pikeperch appear to be low relative to Continental European pikeperch populations (200 000 eggs·kg^{-1}; Deedler and Willemsen 1964), though relative fecundity in pikeperch of the Orava Valley Reservoir is also low (Bastl 1970).

In common with most fish species, absolute fecundity increases with body length, weight and age in Continental European populations of pikeperch (Bastl 1970). Relative fecundity also increases with age but declines after age five

(Zivkov and Petrova 1993); our results are limited by low number but show a pattern consistent with this (Figure 2A), and gonadosomatic index (GSI) also increased with age. Fickling (1980) reported an increase in pikeperch ovary weight after October and a rapid increase after December, whereas ovary weight fell rapidly between April and May during spawning. However, owing to low sample number and the lack of access to samples in other seasons, we are unable to make seasonal comparisons.

Egg size and weight can be correlated to parent female length (Deedler and Willemsen 1964) and this appeared to be the case in our data, but sample size was too small for meaningful analysis. Mean diameter of yolked eggs in our specimens, which did not vary significantly between different parts of the gonad (ANOVA, $P > 0.05$, $n = 120$ for all locations): distal = 0.81 mm SE = 0.008), central = 0.82 mm (0.008), proximal = 0.82 mm (0.009), also appears to increase with fish age/size (ranging from 0.71 to 0.91 mm), but our sample size is too low for statistical comparisons. Our overall mean was 0.827 (SE = 0.004, $n = 451$), which is to the lower end of the range given in Marshall's (1977) review, though the eggs of our specimens were probably at least a month away from maximum ripeness for spawning. Data for pikeperch in the Orava Valley Reservoir, Slovakia, suggest that mean egg diameter reaches its peak at age eight after which a decline in diameter is observed (Bastl 1970).

Perspectives

Spate events, such as occurred in the River Lee in early winter of 1993–4, probably facilitated a downstream displacement of pikeperch and other fish from Stanborough Lake into the River Lee, from the Lee into Hatfield Broadwater, and from the Broadwater downstream into the Sawmill Pond (Figure 1) — all three locations are separated by at least one weir. The assumption of downstream displacement by young pikeperch, whether or not related to spate events, is support by the capture in Hatfield Broadwater of golden rudd (emanating from Stanborough Lake) and rainbow trout *Oncorhynchus mykiss* (emanating from the Lee upstream of Stanborough lake) that had been stocked a few months prior to the 1993–4 spate. Similarly, a recognizable common carp (damaged pectoral fin), which had been caught several times during surveys and by rod and line in the Broadwater, was found downstream in the Sawmill Pond after the 1993–4 spate. A winter spate in late 1995/early 1996 also resulted in the downstream movement of rainbow trout, stocked in the Lee upstream of the Lake and recovered in large numbers post-spate in Hatfield Broadwater.

Captures of pikeperch in the Thames began after the introduction of the species to Old Bury Hill (N. Foulkes, pers. comm.) and Stanborough lakes (Table 1). Given the long phase between Wheeler's (1974) report of pikeperch in the Lee and those from the late 1980s, the 1970s introduction appears not to have lead to a viable, reproducing population. Reports after 1985 of pikeperch in the River Thames at Teddington Lock, where anglers now fish intentionally for the species, result from independent illegal introductions, or migrations of pikeperch from the Old Bury Hill Lake population and possibly from Stanborough Lake via the R. Lee. Dispersal of pikeperch from the Lee into the Thames, and subsequent movement upstream (e.g. to Teddington Lock), is unlikely to be impeded by the estuarine nature of the lower Thames, and a recent report of pikeperch upstream of Teddington Lock at Sunbury Weir (Table 1), suggests that locks may not be an impediment either. Pikeperch have been classed as partially euryhaline (e.g. Koed et al. 2000, Lucas and Baras 2001) but Brown et al. (2001) found the species to tolerate levels up to 30 ‰ if acclimatised gradually. Elsewhere, pikeperch have been reported indifferent to variations in salinity averaging about 12 ‰ (Arzel 2002) and conversely that salinity levels influence their activity patterns (Ložys 2002). Pikeperch migratory behaviour in general, and in particular with regard to salinity, requires further study so as to permit assessment of risks of expansion between adjacent river catchments via

brackish and salt-water corridors. Similarly, the impact of pikeperch on River Lee fisheries is expected to be the subject of further investigation.

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TABLE 1. Details of pikeperch *Stizostedion lucioperca* occurrences surrounding their introduction into Stanborough Lake, River Lee catchment, England (R&L = Rod & Line, N&E = seine netting and electrofishing, ENU = exact number unknown, acoustic = Eagle Magna Echosounder.

Month/season	Year	Event	Means	Location	No. of specimens	Wt. Min/max or mean (kg)	Comments
Oct/Nov	1985	capture	R&L	Gt. Ouse Relief Channel (Denver Sluice)	10	1.3–2.3 kg	
Oct/Nov	1985	release	—	Stanborough Lake	10	1.3–2.3 kg	6 survived
	1987*	capture	R&L	Lower River Thames	1	2.46 kg	(Bill Rushmer*)
Summer	1988	capture	R&L	Stanborough Lake	>10	10–15 cm TL	during match
Summer	1988	release	anglers	River Lee at Stanborough	>10	10–15 cm TL	during match
May	1991	survey	N&E	Stanborough Lake	19	0.5–5.0 kg	
March	1992	cull	N&E	Stanborough Lake	≈ 300	all sizes	fish removed
	1992	capture	R&L	Stanborough Lake	ENU	1.4–3.2 kg	
	1992	release	anglers	River Lee at Stanborough	ENU	1.4–3.2 kg	
Dec.	1992[Y]	capture	R&L	River Lee at Hertford	1	13–14 cm TL	
Jan.	1993	capture	R&L	River Lee at Wormley, Kings Weir	1	17.8 cm TL	
	1993–94	surveys	electro	River Lee at Mill Green	5	0.5–2.3 kg	fish removed
	1995	sighting	observed	Hatfield Broadwater	1	large specimen	
	1995	survey	seine	River Lee at Sawmill Pool	6	15–20 cm TL	
	1996–97	capture	R&L	River Lee at Stonebridge Lock	1	not recorded	
	1997	capture	R&L	River Lee at Sawmill Pool	1	1.49 kg	
Feb.	1999	capture	R&L	River Lee at Hertford (canal stretch)	1	4.7 kg	
Oct.	1999	capture	R&L	River Lee at Stanborough	2	45-50 cm TL	
Dec–Jan.	2000	survey	R&L	River Lee at Sawmill Pool	6	1.4–2.3 kg	fish removed
Dec–Jan.	2001	survey	R&L	River Lee at Hatfield BW & Sawmill Pool	11	1.1–2.3 kg	fish removed
early	2001[†]	survey	seine	River Thames at Teddington	1	8 cm FL	1.4–2.7 kg fish taken by anglers
	2001	capture	R&L	Stanborough Lake	>10	sizes unavail.	during mateh
October	2001[†]	capture	R&L	River Thames at Teddington	2	1.0 kg, 2.49 kg (65 cm FL)	
	2002	survey	acoustic	Stanborough Lake	>10	sizes unavail.	
various dates		capture	R&L	River Lee at Dobb's Weir (Crown Fishery)	>10	sizes unavail.	numerous reports
after 1964		record		tidal Thames	ENU	size unavail.	Kirk et al. (2002)
various dates		capture	R&L	R. Thames, Richmond to Walton/Thames	ENU	about 0.373 kg	(Bill Rushmer*)
recent years	2002*	capture	R&L	River Thames at Hampton Court	>40	305–356 mm TL	
September	2002	capture	R&L	River Mole/Thames at Molesey Weir	8	1.13–1.58 kg	N. Foulkes (pers. comm.)
Spring	2003	capture	R&L	River Thames at Sunbury Lock	ENU	sizes unavail	angling press reports, N. Foulkes (pers. comm.)
March	2003[‡]	capture	R&L	Stanborough Lake	1	4.95 kg	*Angler's Mail*, March 2003
May	2003	capture	electro	River Lee Navigation at Enfield Lock	1	1.59 kg (482 mm FL)	

*Cited by Anonymous (2002), [Y]cited in DAFF (2002), [†]EA-Thames, NGR: TQ 1670771491 (T. Cousins and N. Foulkes, pers. comm.), [‡]capture witnessed by M.G. Carter.

TABLE 2. Mean, standard error (SE), standard deviation (SD) and coefficient of variance (C. var.) for mensural characters expressed in % of standard length of 59 pikeperch from Stanborough Lake and Hatfield Broadwater (Hertfordshire) and Ash Drain (Great Ouse Middle Level (Cambridgeshire). The mean for pikeperch from the Danube (†) is included for comparison (as derived from Krpo-Ćetković & Stamenković 1996).

Character	**Mean**	**SE**	**SD**	**Min.**	**Max.**	**C. var.**	**Danube†**
Total length (cm)	41.11	0.247	14.59	11.10	70.20	35.485	—
Fork length (cm)	38.91	0.236	13.94	10.30	66.60	35.819	30.49
Standard length (cm)	33.76	0.207	12.21	9.00	59.00	36.177	27.63
In % of standard length							
Head length	30.04	0.020	1.19	27.40	33.40	3.950	29.99
Preorbital distance	7.25	0.006	0.38	6.80	8.30	5.234	7.28
Eye diameter	4.73	0.015	0.89	3.30	7.20	18.839	5.11
Postorbital distance	18.08	0.013	0.77	15.60	19.50	4.267	17.59
Maxilla length	13.13	0.007	0.43	11.90	14.40	3.241	12.54
Head depth	14.49	0.013	0.74	12.70	16.20	5.108	14.64
Head width	10.93	0.013	0.76	9.70	13.20	6.945	—
Predorsal distance	32.63	0.015	0.89	30.80	35.40	2.729	33.02
Preventral distance	32.78	0.017	0.99	30.70	35.50	3.005	32.50
Preanal distance	65.51	0.027	1.59	61.50	68.40	2.435	64.54
P – V distance	7.55	0.008	0.45	6.40	8.40	5.938	7.36
V – A distance	33.15	0.023	1.36	29.90	36.10	4.109	32.51
Body depth	18.95	0.016	0.96	17.20	21.00	5.048	19.62
Body width	12.33	0.018	1.08	9.10	15.40	8.737	—
Caudal peduncle length	23.63	0.019	1.13	21.20	26.70	4.781	21.92
Caudal peduncle depth	11.61	0.014	0.80	9.20	13.00	6.868	—
Minimum body depth	8.23	0.007	0.40	7.50	9.10	4.843	8.32
Dorsal fin 1 length	27.40	0.029	1.72	22.90	30.30	6.263	26.62
Dorsal fin 2 length	25.26	0.033	1.95	16.10	30.40	7.713	24.59
Anal fin length	13.04	0.012	0.73	11.10	14.70	5.624	13.15
Pectoral fin length	16.27	0.023	1.34	13.90	20.60	8.219	16.60
Ventral fin length	17.06	0.026	1.52	13.40	21.30	8.912	17.73
Caudal fin length	17.32	0.032	1.92	12.40	23.30	11.061	17.72
Dorsal fin 1 depth	12.00	0.022	1.27	9.40	15.00	10.628	12.30
Dorsal fin 2 depth	12.23	0.022	1.29	10.00	15.70	10.579	13.54
Anal fin depth	13.35	0.020	1.15	10.90	16.70	8.643	—

TABLE 3. Mean, standard error (SE), standard deviation (SD) and coefficient of variance (C. var.) for mensural characters expressed in % of head length of 59 pikeperch from Stanborough Lake and Hatfield Broadwater (Hertfordshire) and Ash Drain (Great Ouse Middle Level (Cambridgeshire). The mean for pikeperch from the Danube (†) is included for comparison (as derived from Krpo-Ćetković & Stamenković 1996)

Character	**Mean**	**SE**	**SD**	**Min.**	**Max.**	**C. var.**	**Danube†**
Total length (cm)	41.11	0.247	14.59	11.10	70.20	35.485	—
Fork length (cm)	38.91	0.236	13.94	10.30	66.60	35.819	30.49
Standard length (cm)	33.76	0.207	12.21	9.00	59.00	36.177	27.63
In % of head length							
Preorbital distance	24.12	0.022	1.30	21.70	28.40	5.381	24.26
Eye diameter	15.76	0.048	2.84	11.20	23.20	18.031	16.98
Postorbital distance	60.36	0.050	2.94	50.70	66.60	4.869	58.76
Maxilla length	43.84	0.027	1.59	39.50	49.20	3.632	41.75
Head depth	48.34	0.039	2.31	43.40	53.60	4.787	48.90
Head width	36.41	0.047	2.75	31.70	42.70	7.560	—
P – V distance	25.20	0.031	1.82	20.00	28.50	7.228	25.57
Body depth	63.21	0.073	4.28	53.50	74.30	6.773	65.61
Body width	41.16	0.072	4.25	28.30	52.80	10.334	—
Caudal peduncle length	78.60	0.075	4.43	70.60	92.90	5.638	73.17
Caudal peduncle depth	38.55	0.055	3.22	29.20	43.00	8.355	—
Minimum body depth	27.46	0.028	1.68	23.10	31.40	6.109	27.80
Dorsal fin 1 length	91.46	0.123	7.25	73.20	103.30	7.931	89.02
Dorsal fin 2 length	84.14	0.115	6.80	53.70	100.20	8.084	82.19
Anal fin length	43.54	0.045	2.67	37.30	49.30	6.129	43.93
Pectoral fin length	54.14	0.057	3.38	47.00	61.80	6.241	55.37
Ventral fin length	56.74	0.076	4.48	46.60	69.40	7.898	59.14
Caudal fin length	57.57	0.086	5.07	44.20	75.30	8.808	58.87
Dorsal fin 1 depth	40.04	0.063	3.73	32.60	46.40	9.320	40.97
Dorsal fin 2 depth	40.62	0.060	3.54	33.30	47.00	8.709	45.12
Anal fin depth	44.42	0.057	3.34	37.30	56.90	7.509	—

TABLE 4. Meristic data for pikeperch *Stizostedion lucioperca* from English waters compared with that of other European locations († from Oliva and Safranek 1962). The mean† for pikeperch from the Danube is included for comparison (as derived from Krpo-Ćetković and Stamenković 1996).

		1st dorsal fin spines					2nd dorsal fin spines			2nd dorsal bifurcated fin rays							
Source	**n**	**XII**	**XIII**	**XIV**	**XV**	**XVI**	**I**	**II**	**III**	**<16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
Stanborough Lake	30	1	8	18	2	1		11	15		1		1	2	5	13	7	1
River Great Ouse canals	29	1	13	15				12	15		2	1		3	7	14	2	
River Elbe†	117	1	40	65	11		23	88	6					8	45	46	14	2
River Danube basin†	5		1	3	1		2	2						1		2		1
Bulgaria†	4		2	2			2	2							2	1	1	
English mean	59	13.6 D1-fin spines (SE = 0.90)					2.8 D2-fin spines (SE = 0.08)			20.3 D2-fin bifurcated rays (SE = 0.27)							
Danube mean†		14.1 D1-fin spines (SE = 0.10)					1.9 D2-fin spines (SE = 0.08)			21.5 D2-fin bifurcated rays (SE = 0.10)							

		Anal fin spines				Bifurcated anal fin rays				
	n	**I**	**II**	**III**	**IV**	**8**	**9**	**10**	**11**	**12**
Stanborough Lake	30		9	21		1	3	9	12	5
River Great Ouse canals	29			28	1		2	23	4	
River Elbe†	114	1	112	1		1	19	68	26	
River Danube basin†	5		5					3	2	
Bulgaria†	4		4				1	1	2	
English mean	59	3.0 A-fin spines (SE = 0.51)				10.9 A-fin bifurcated rays (SE = 0.10)				
Danube mean†		2.4 A-fin spines (SE = 0.06)				11.8 A-fin bifurcated rays (SE = 0.10)				

TABLE 5. Linear regression (y = bx + a) coefficients, F-test and probabilities (P) for pikeperch *Stizostedion lucioperca* from some English waters (Stanborough Lake/River Great Ouse drains, the present study; the Grand Canal (Smith and Eaton 1995), from France (Goubier 1969/70), and 0+/1+ specimens from the Czech and Slovak Republics (Mušov Reservoir (Prokeš 1990); Orlík and Orava Reservoirs (Závěta and Velebný 1989)). Also given are the logarithmic regression ($Log_{10}y = b*Log_{10}x + a$) relationships between standard length (SL), fork length (FL), weight (Wt) and statistical information (when available).

Regression/Data source	n	b	a	r^2	F	P
FL vs. SL (Stanborough/Gt. Ouse, UK)	59	1.093	0.961	0.999	73067.7	0.0001
TL vs. SL (Stanborough/Gt. Ouse, UK)	59	1.159	1.026	0.999	43736.9	0.0001
TL vs. SL (Mušov Reservoir, Czech R.)	61	0.838	-0.716	0.998		
TL vs. FL (Stanborough/Gt. Ouse, UK)	59	1.060	0.017	0.999	57982.9	0.0001
TL vs. FL (Étang du Vaccarès, France)	239	0.960	-5.200	0.999		
TL vs. FL (River Tarn at Moissac, France)	28	0.970	-9.100	0.999		
FL vs. TL (Mušov Res., Czech R.)	55	0.942	-0.413	0.999		
log Wt vs. log SL (Stanborough/Ash, UK)	53	3.171	-2.123	0.996	11920.6	0.0001
log Wt vs. log SL (Herault & Tarn, France)	37	3.034	-11.750	0.970		
log Wt vs. log SL (Orlík Reservoir, Czech R.)	70	4.123	-7.205	0.991		
log Wt vs. log SL (Orava Reservoir, Slovakia)	†	3.101	-5.161			
log Wt vs. log FL (Stanborough/Ash, UK)	53	3.258	-2.420	0.996	13189.0	0.0001
log Wt vs. log FL (Grand Canal, UK)	80	2.970	-4.880	0.970		0.0100

† formula calculated by Závěta and Velebný (1989) from data in Bastl (1965).

Book review

The breeding birds of the London Area — The distribution and changing status of London's breeding birds in the closing years of the 20th century. Edited by Jan Hewlett. London Natural History Society. 2002. 294 pp., A4. £30. ISBN 0 901009 12 1.

This substantial volume updates the *Atlas of breeding birds in the London Area* produced by David Montier in 1977. Some quite incredible changes since the early 1970s are documented. Although fieldwork for this new atlas in the London Area began in 1988, when fieldwork for the BTO National Atlas also began, it continued on to 1994. Much additional data has also been gathered since then. In all 856 tetrads (2-km × 2-km squares) were surveyed within a radius of 20 miles (32 km from St Paul's Cathedral, covering Middlesex and sectors of Essex, Hertfordshire, Buckinghamshire, Surrey and Kent.

The new atlas, the result of all this fieldwork by a dedicated band of more than 250 observers, is a fitting tribute to their efforts. It is very much a team effort, apart from the people in the field, more than twenty people prepared draft texts and nineteen artists provided illustrations. Keith Betton was survey co-ordinator, Jan Hewlett overall editor with an editorial advisory group of Paul Cornelius, Mike Dennis, Ron Kettle, David Montier and Andrew Moon. Responsibility for the maps rested on Mike Earp's shoulders and for the cover design, on those of Ken Osborne.

It was fitting that the foreword for this book should have been written by Richard Fitter as he is probably the oldest surviving editor of the *London Bird Report*. He draws attention to the first major work on birds in the area, *The birds of the London Area since 1900* published in 1957, followed twenty years later by David Montier's breeding atlas. He notes that the changes as described in the present atlas would have been inconceivable to birdwatchers of the 1930s and 1940s when nobody had even heard of collared dove! The late Max Nicholson, who in 1995

published the results of his own observations from 1924 (*Bird-Watching in London)* also comments in a brief chapter of 'Historical Perspectives' on the amazing losses and gains of birds during the last century. For example, rooks and jackdaws no longer breed in Inner London, whereas jays and magpies now abound.

After a brief introduction and description of the methodology, there follows a fascinating chapter that highlights some of the habitat changes over the thirty years, both losses and gains, and links this with the changing fortunes of birds of each habitat type. Habitat losses have been enormous due to industrial and housing development on derelict and green-field sites and to the construction of new roads and motorways. Intensive agriculture has had adverse effects on birds, as elsewhere. On the plus side though are many new wetlands formed after gravel and sand has been extracted, and the greater tolerance and interest of people in wildlife conservation, resulting in more sympathetic management of parks, churchyards and gardens. The trend to milder winters has undoubtedly benefited species such as Dartford warbler and woodlark. The adaptability of some species of bird has also led to dramatic increases in for example, colonies of gulls on rooftops and common terns on rafts in Docklands. Firecrest bred first in 1980 and fieldfare once, in 1991.

It is encouraging that the number of species which appear to have extended their distribution since the 1977 atlas has been greater than the number that have declined. With some caveats because coverage in the two atlas periods did differ, the last atlas having better coverage, forty-four species appear to have increased their breeding distribution by 20 per cent or more whilst only fifteen species have decreased by 20 per cent or more. Nine new species bred between 1988 and 1994 that were not recorded in the first atlas but three of these new additions were naturalized species (barnacle and Egyptian geese and ring-necked parakeet). On the debit side wryneck, red-backed shrike and cirl bunting disappeared as breeding species between the atlases and since the end of the survey redstart, wood warbler and willow tit have also apparently been lost as breeding species, with tree sparrow and corn bunting also now extremely scarce. I could ramble on as this chapter is so full of interesting snippets about the increases and decreases — hobby for example, was suspected of breeding in just five tetrads in the first atlas but occurred in eighty-four tetrads between 1988 and 1994. By contrast turtle dove and willowtit have respectively, undergone 45 per cent and almost 50 per cent declines in distribution between the two periods. I will stop though and encourage you to read it for yourself and then to browse through the species texts.

The meat of this atlas is of course the information. Each species is given a page of detailed, very informative text, typically six paragraphs, summarizing the species' requirements and its historical and current status and distribution, its main localities or strongholds and suggested reasons for changes in status and distribution. There is too the standard vignette for each species; these have been drawn by nineteen different artists and are of a high standard and add to the book's attractions. On the opposite page to the text are three maps per species. The largest map shows the distribution during the recent atlas period, with just two dot sizes — large for probable or proven breeding and small for presence only. The two small maps below show, on the left, the 1977 distribution and, on the right, the gains (blue dots), the squares occupied in both atlas periods (grey dots) and the losses (open circles). One minor criticism here is that the eye is drawn to the blue dots whereas the open circles stand out much less well. Of particular value is a small summary table giving the number of tetrads for each atlas with evidence of breeding or with presence only. I looked in particular at texts of species I know well and was gratified to see that grey wagtail was recorded in 292 tetrads compared with just 107 in the first atlas. In Wales it is similarly more abundant than previously and yet the species has been placed on the Amber List of birds to watch! It is hard to see why. Yellow wagtails have 'bucked' the national trend and actually increased in distribution though the text notes actual numbers are down. Presence or evidence of breeding for kingfisher has also increased from 137 tetrads to 317.

The final two chapters cover recent additions to breeding birds since the end of the fieldwork for this atlas in 1994 and losses of species since1968–72. Half of the ten new additions are non-native species — wood ducks from North America, ruddy shelduck from central Asia, Eastern Europe and NW Africa, monk and blue-crowned parakeets from South America and Alexandrine parakeet from SE Asia. Among the native new breeders are peregrines and common buzzards. Peregrines nested successfully in central London in 2000, on Battersea Power Station. Now three pairs breed in the London Area. Other new colonizers are pintail, possibly resulting from escapes from St James's Park, avocet and black-headed gull. What next?

The London Natural History Society is to be warmly congratulated on this excellent production. It provides an admirable model for future county 'repeat' atlases. London has probably had more fieldwork directed at it than any other area in Britain or indeed elsewhere in the world. Having been living and working in Botswana for five years I only wish that just a handful of London's experienced fieldworkers could be transported there for a year. Botswana is roughly the size of France and yet has far fewer than twenty competent birders. Although there is a *Bird atlas of Botswana* (H. Penry 1994) this is based on huge squares — quarter degree squares, roughly 50 km × 50 km, and an enormous amount of survey work remains to be done.

STEPHANIE J. TYLER

Report of the second London ladybird survey, 2001–2002

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Introduction

The number of contributors to the survey increased markedly in 2001 and seems to have stabilized in 2002. The abundances of common ladybirds returned to moderate levels after their serious decline during 1998–2000 although some species may have declined during 2002. This report briefly summarizes the data, considers difficulties of interpreting and reporting the records, and notes some interesting observations.

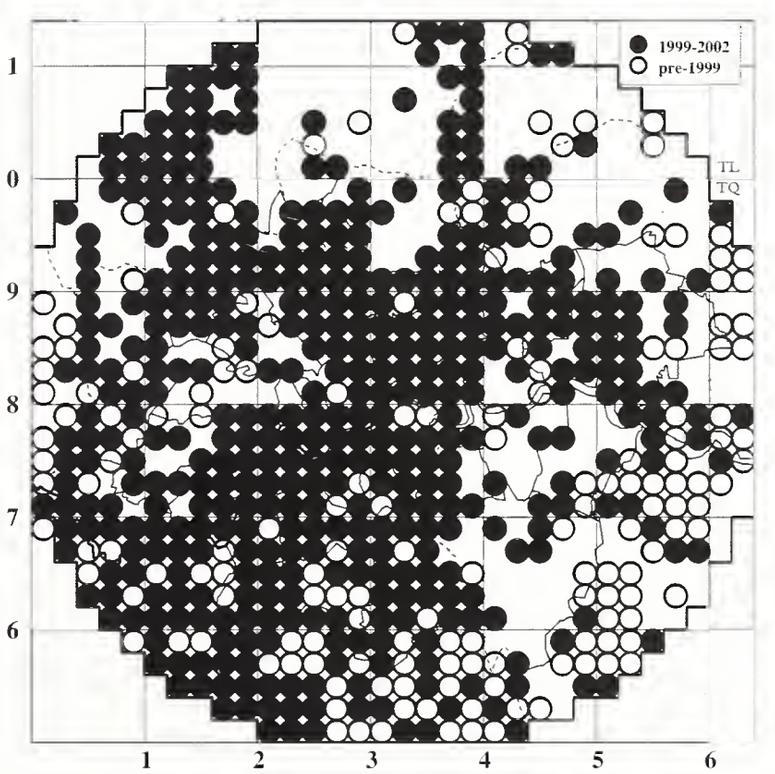

FIGURE 1. Tetrads from which ladybirds have been recorded.

Observers and observations

Records for 2001 and 2002 were contributed by 149 and 77 observers respectively compared to 59 for 2000. Figure 1 demonstrates the coverage. Surrey is well recorded (due largely to Roger Hawkins and his colleagues), as is SW Hertfordshire, S Essex and Middlesex (except for Enfield). Recording is patchier in Kent, rural Essex and parts of SE Herts. Table 1 lists records (species per observer per week) and the average numbers of individuals per record. Difficulties in reporting the accounts have been noted previously but might be reiterated.

TABLE 1. All coccinellid species reported during 2001 and 2002.

Species		Records				Individuals (mean)			
		2002	2001	2000	1999	2002	2001	2000	1999
Adalia bipunctata	2-spot	663	1,009	202	175	4.5	6.5	3.7	4.8
Coccinella septempunctata	7-spot	582	535	136	105	9.5	4.1	2.7	2.4
Exochomus quadripustulatus	Pine	315	188	38	40	11.9	11.4	2.8	3.7
Propylea quattuordecimpunctata	14-spot	102	109	50	50	3.6	1.6	1.4	1.4
Halyzia sedecimguttata	Orange	98	146	109	45	3.6	13.8	22.5	23.4
Psyllobora vigintiduopunctata	22-spot	71	113	114	63	2.1	3.7	2.0	1.3
Adalia decempunctata	10-spot	58	136	44	51	1.8	1.8	2.8	2.1
Calvia quattuordecimguttata	Cream	29	42	26	28	1.4	1.2	1.1	1.5
Subcoccinella vigintiquattuorpunctata	24-spot	28	44	52	28	5.1	6.8	3.3	1.1
Chilocorus renipustulatus	Kidney-spot	28	29	20	6	2.1	2.9	4.0	1.7
Anisosticta novemdecimpunctata	Water	20	18	7	2	18.7	3.2	2.9	4.5
Harmonia quadripunctata	Cream-streaked	14	3	17	3	1.7	1.0	0.9	2.3
Epilachna argus	Bryony	11	10	20	6	4.5	12.6	10.7	14.2
Tytthaspis sedecimpunctata	16-spot	10	21	24	12	7.5	1.1	1.5	1.0
Hippodamia variegata	Adonis'	6	28	18	9	4.3	2.4	1.0	12.1
Coccinella undecimpunctata	11-spot	4	9		2	1.0	1.0		5.5
Rhyzobius chrysomeloides		4	5	2		1.3	1.8	2.0	
Chilocorus bipustulatus	Heather	4	2			1.8	1.0		
Nephus quadrimaculatus		2	4	2		1.0	2.0	1.0	
Anatis ocellata	Eyed	2	1	2	3	1.5	1.0	5.5	1.0
Clitostethus arcuatus		2			4	7.0			1.0
Aphidecta obliterata	Larch	1	4	1	3	1.0	3.0	4.0	1.0
Myrrha octodecimguttata	18-spot	1	4	1	4	1.0	1.0	1.0	1.3
Scymnus suturalis		1	1	3	2	31.0	1.0	1.0	1.0
Rhyzobius litura			8	38	16		2.1	1.2	1.1
Coccinella hieroglyphica	Hieroglyphic		4	4	1		1.3	1.3	1.0
Platynaspis luteorubra			4	1			3.5	1.0	
Coccidula rufa			1	11	2		1.0	1.2	1.0
Cheilomenes lunata			1				1.0		
Coccidula scutellata			1		1		1.0		1.0
Scymnus frontalis			1				11.0		
Total		2,056	2,481	942	661				

(a) there are delays in receiving records, leading to continuous revision of overall annual figures. Comparison of the figures given here for 1999 and 2000 with those published in the previous report (Mabbott 2001) shows such discrepancies and more are likely to occur for the 2002 figures! The amended figures have not affected interpretation but such adjustment is unsatisfactory and will be avoided by delaying future reports.

(b) for a variety of reasons, reporters join and leave the survey, necessitating adjustment of the annual figures to allow for recorder effort. Table 2 illustrates fluctuations of common species abundance adjusted for number of reporters, expressed as percentage increase or decrease over the 1999 baseline, as in the previous report.

(c) recording is heterogeneous: contributors range from professional entomologists to 'lay' members of the public. Some naturalists have become very keen and proficient while other people record only very occasional, incidental observations. Entomologists provide most of the information on rarer species and sample many unusual sites; on the other hand their reports are often not quantitative and these sites may never be visited again. Most members of the public contribute regular records from single sites, commonly gardens; these

data are very useful for assessing phenology and population changes of the more abundant species. Some naturalists visit more than one site and have become more skilled at identifying unusual species and variants, recording activity in detail. All observers provide valuable information but the various strands need separating for useful analysis. This will be time-consuming and best performed after several more years of recording.

TABLE 2. Change of frequency (percentage) of common ladybirds, adjusted for recording effort. All species for which more than fifty records were received during 2001–2002; see text for method of adjustment.

	Increases as a percentage of 1999							
	2000		2001		2002		Totals 2001/02	
Species	**Records**	**No's**	**Records**	**No's**	**Records**	**No's**	**Records**	**No's**
Adalia bipunctata	-19	-45	238	435	204	182	1,672	9,522
Coccinella septempunctata	-5	17	171	555	379	2,073	1,117	7,760
Exochomus quadripustulatus	-39	-63	131	1,123	613	2,380	503	5,905
Halyzia sedecimguttata	108	100	-14	-147	43	-142	244	2,364
Propylea quattuordecimpunctata	-34	-34	-121	-104	29	336	211	537
Adalia decempunctata	-48	-18	-72	-115	-61	-79	194	346
Psyllobora vigintiduopunctata	47	146	-159	175	-62	5	184	569
Subcoccinella vigintiquattuorpunctata	52	439	-182	655	-75	298	72	440
Calvia quattuordecimguttata	-41	-69	-189	-220	-71	-82	71	91
Chilocorus renipustulatus	199	656	145	501	292	405	57	142

Another potential problem has been noted previously but it is only in 2002 that it has mattered: use of the calendar year in reports may not reflect true population changes. The life-span of ladybird imagines runs roughly from June of one year to May of the next whereas our reports are from January to December. This has not mattered in early years because population declines occurred in winter or early spring. Table 1 suggests that 7-spot ladybirds were more abundant in 2002 than in previous years but the calendric data obscure the observations of a decline in abundance, particularly of the 7-spot, during summer 2002. This decline is probably related to the wet and windy early summer in that year. In future it may be necessary to present the data based on biological rather than calendric years.

Notes on selected species

'New' and exotic species

Keir Mottram found a specimen of the large African ladybird *Cheilomenes lunata* on 26 December, 2001. Subsequent investigations revealed other finds of the species mainly associated with South African grapes in supermarkets (Mabbott 2002). The dispersal of this species from east Kent (where a consignment of grapes entered the country) via Monmouth (whence packages were distributed) throughout the country as far north as Perth is a serious reflection on our food provision system. Further specimens, presumably from a different importation, were found in March. Additionally, a single specimen of *Eriopis connexa*, a South American ladybird, was recognized by John Dobson (pers. comm.), having been found in a Harrow supermarket by Mrs Hollingworth. These are not likely to establish in Britain. However, other European species may migrate or possibly be undiscovered. Dan Hackett found *Scymnus rubromaculatus*, new to Britain, by the lower Lea. Similar finds are likely. The most recently established large ladybird, the **bryony** *Epilachna argus*, continues to spread from its initial sites around Molesey, having crossed the Thames to Kempton Park (James Ranger) in 1999 and spread eastward to Kew during 2001, progressing north to Greenford and Northolt Country Park (Neil Anderson) and west to Ashford (Frank Canning) during 2002.

Arboreal species

The previous report suggested under-recording of the **pine ladybird**. The summary tables confirm this: now that some recorders have started examining tree trunks, large numbers of the species have been found; the 2,000 per cent increase in numbers is thus artefactual. Other common arboreal species, especially the **cream-spot** and **10-spot ladybirds**, are also likely to be underestimated. Since these spend most of their lives in tree canopy, they are less likely to be seen and the survey is unlikely to produce meaningful information about their abundance. Large aggregations of **orange ladybirds** such as those noted in 1999 (Mabbott 2000) have not been seen over recent years. However, the species is now widely reported throughout the London Area. Sightings are mainly of singletons, thus (Table 2) numbers of records have increased but numbers of individuals declined. Two other species have been seen more often although in such small numbers that conclusions cannot yet be drawn. The **cream-streaked ladybird** has been found in modest numbers on conifers of Hampstead Heath (along with the **18-spot**) but also in Mile End. The **kidney-spot ladybird** has also been found in inner London. It is tempting to speculate that, like the pine ladybird, it might be prey-switching to other species of scale insect. The **heather ladybird** has previously only been reported from heaths, mainly in Surrey, where it is found on heather and conifers (especially juniper) (Hawkins 2000). In 2002 it was reported from some unusual sites away from heath including a Croydon garden (Graham Collins) and wasteland at Chelsea Harbour (Max Barclay). These may have been introduced with garden plants; however on Continental Europe the species feeds on a wide variety of coccids so prey-switching is not impossible. There are numerous similar *Chilocorus* species globally, the 'twice stabbed ladybirds', some of which are used for biological control and might thus be imported on plants. Verification of all ectopic *Chilocorus* is essential.

Ladybird mortality

Extreme or inconsistent weather has been blamed for fluctuations of ladybird populations: cold, wet winters are bad for most beetles and late vernal cold snaps may kill unprotected ladybirds and their prey. Heavy rainfall may cause high mortality mainly by washing away and drowning prey: this may be why aphidophagous species seem to suffer wider population fluctuations: the food of phytophages, mycetophages or predators of coccids is less likely to be affected by weather than are aphids. However, predation and disease may obviously have a considerable impact on ladybird abundance. There may be links with climate; for instance Welch et al. (2001) have noted raised levels of infestation of 2-spots in London by the pathogenic Laboulbeniales fungus. They attributed this to the urban heat island allowing overwintered ladybirds to survive longer in the year and the new generation to appear earlier, this greater overlap of generations increasing the chances of sexual transmission.

Ladybirds are affected by many parasitoids. Study of these has been patchy. Disney et al (1994) summarized dipteran parasitoids and Majerus (1994) noted some hymenopteran ones. Work continues nationally on the braconid *Dinocampus coccinellae*. This had been noted at high incidence in Scotland (Geoghegan et al. 1997) but only two records of this (both by Diane Andrews at Alexandra Park in different years) have been reported to the survey. There are problems of identification of the smaller parasitoids including their size and lack of identification keys. In the case of the Tetrastichinae, the latter has been overcome by Graham (1987) and one species, *Aprostocetus neglectus*, has been identified as a major parasite of pine (Mabbott and Mabbott 2003) and cream-spot ladybirds. *A. neglectus* has now been found in Middlesex and Essex by Denzil Devos and Diane Andrews respectively. The survey may make a considerable contribution to studies of such parasitoids.

Summary

Large numbers of records are accumulating which require detailed analysis after several more years. Summaries of the basic data, along with notable observations, will be published in this journal at extended intervals. The observations are producing insights to ladybird life history which may be amplified after several more years.

Acknowledgements

Roger Hawkins and John Muggleton continue to give valuable advice. Eric Philp has provided records from non-metropolitan Kent. Many records were contributed as part of the Essex Field Club's concurrent Essex ladybird survey; Peter Hammond has kindly shown me the Coccinellidae section of his work in progress on the beetles of Essex. Thanks go to those reporters listed in the last report and also to: Saddat Abdul-Hakim, Maureen and George Anastasi, Sandra Bell (Royal Botanic Gardens, Kew), Nick Carter, Stuart Cole, Jonty Denton, Becky Franklin, Ian Harragan, Lester Hunt, Michael J. J. Keogh, J. Edward Milner, Pat Painter, Peter Peretti, Tricia Shaw, Johnny Slattery, Howard J. de Voil, George Washington and Jan Willy. My apologies for any omissions from this ever-increasing list.

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Book reviews

Windermere: restoring the health of England's largest lake. A.D. Pickering. 2001. 126 pages, paperback. Special Publication No. 11, Freshwater Biological Association, The Ferry House, Far Sawry, Ambleside, Cumbria LA22 0LP. £10.00. ISBN 0 900386 68 1.

This fascinating book on Windermere was written to celebrate the fiftieth anniversary of the Lake District National Park and to inform the interested non-specialist about the major issues that impact upon the water. Alan Pickering has produced a very readable account that firstly describes the geography, geology and historical development of Windermere and then focuses on its ecology and the impact of human activities. It is a great irony that the most dramatic of human impacts was caused by well-intentioned improvements to the waste-water treatment process in the catchment area which led to phosphorus enrichment in Windermere. Before the middle of the twentieth century, much of the sewage in the local catchment was treated by numerous septic tanks which inactivated phosphorus from wastes through chemical and biological interaction with soil. However, the increasing pressures of population growth and tourism resulted in the construction of sewage treatment works that discharged treated sewage effluent into Windermere. This standard practice relies on further purification of treated effluent by natural biological processes within a water body. However, such effluents contain high concentrations of phosphorus in a form that is immediately available for plant growth, resulting in excessive algal productivity and subsequent deoxygenation of the water due to decomposition of the algae. The ecological balance of the lake was thus threatened to the extent that there was no measurable oxygen in parts of the lake in 1988. These problems had the greatest impact upon the rare Arctic charr populations in the deeper, colder parts of the lake. Pickering describes how a partnership of scientists and environmental managers collaborated to restore water quality in Windermere through research and addition of phosphate stripping procedures to local sewage treatment works in 1992. I thoroughly enjoyed this book as it explains all scientific jargon used and contains some wonderful photographs to illustrate the story of Windermere. It will definitely be added to my book collection.

The phytoplankton of Windermere (English Lake District). C.S. Reynolds and A.E. Irish. 2000. 73 pages, paperback. Special Publication No. 10, Freshwater Biological Association. £20.00. ISBN 0 900386 65 7.

This book on the phytoplankton of Windermere will be another addition to my collection, but for different reasons. This is a scientific account that provides detailed knowledge originating from one of the world's longest and most comprehensive data studies on phytoplankton. Reynolds and Irish describe the physical-chemical features of Windermere and its catchment and the influence of the light and temperature regime on algal physiology. The development of phytoplankton studies in Windermere is summarized with the sequence of events during 1965 used as a baseline comparison for evaluating the changes that occurred in the freshwater body shortly afterwards. It was at this time that the lake began to receive direct discharges of phosphorus-rich effluent from sewage treatment works and the effects of eutrophication (nutrient enrichment) were observed, particularly in the changes to the phytoplankton. This book not only provides valuable details on the dynamics of the phytoplankton populations through eutrophication and restoration, but also clearly describes how phytoplankton respond to environmental influences. The account complements the more general text on Windermere for those who want to know more about phytoplankton and it is superbly illustrated by the photographs of algae by Dr Hilda Canter-Lund.

Keys to the freshwater microturbellarians of Britain and Ireland, with notes on their ecology. J.O. Young. 2001. 142 pages, paperback. Freshwater Biological Association Scientific Publication No. 59. £16. ISBN 0 900386 66 5.

Keys to larval and juvenile stages of coarse fishes from fresh waters in the British Isles. A.C. Pinder. 2001. 136 pages. Freshwater Biological Association Scientific Publication No. 60. £20. ISBN 0 900386 67 3.

Keys to the freshwater microturbellarians enables users, for the first time, to identify 56 species of free-living microtubellarians. Turbellarians are flatworms which can be divided into the Macroturbellaria (such as the common *Dugesia*) and the Microturbellaria. The latter are less widely known because of their small size (most are up to 3 mm in body length) and tendency to scrunch up into an unrecognizable mass when pond samples are preserved in formalin. This key contains valuable information on classification, collection, preservation and methods of identification. The customary summary of the literature on biology and ecology is much appreciated as most of it is available only in German.

Larval fish are generally (but not always) larger than microturbellarians, but can be just as difficult to identify. This is due to the high number of developmental changes that occur during the morphogenesis of young fish and has caused considerable neglect of these early stages and their role in the aquatic ecosystem. The **keys to larval and juvenile stages of coarse fishes** comprise keys to five developmental stages of freshwater fish in the British Isles, illustrated by excellent photographs and line drawings. The text also contains useful notes on spawning biology, collection, preparation and preservation of samples.

RUTH KIRK

As we prepare to go to press we have received three new titles from FBA: Special Publication No. 12 — *Guide to the identification of soil Protozoa — testate amoebae*, £8; Scientific Publication No. 61 — *Keys to the case-bearing caddis larvae of Britain and Ireland*, £22; and (published by the Brathay Exploration Group Trust) — *Tarns of the central Lake District*, £12. Ed.

The beetles of Downham Woodland Walk — little more than a farm track, or ancient woodland?

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Summary

Winding its way through dense housing in Downham, in south-east London, a narrow wooded byway acts as a local footpath. It runs for about one and a half kilometres, then peters out. It is only a few metres wide in most places, nevertheless, there are some old trees and pollards, which appear to pre-date the 1930s houses that back onto it for its entire length. Remarkably, this extremely narrow woodland is not a modern creation and appears to be at least 200 years old. The beetle fauna of the Woodland Walk supports the notion that it is a relic of ancient woodland and is remarkably diverse for such a small and very urban locality.

Introduction

Downham Woodland Walk is a narrow wooded pathway, zigzagging through dense housing between Catford and Bromley, in south-east London. It appears to be a remnant of woodland that has existed in more or less its modern form for over 200 years. A map of 1805 clearly shows the eastern half of the Walk as a narrow strip of woodland. Stanford's 1862 'Library map of London and its suburbs' shows this section extended south and west to mark the boundary of the park attached to Southend Hall. A map from the early 1900s shows the situation almost unchanged except that the park has been divided into fields. For many years it was the wooded boundary along the north and western edges of two adjacent rectangular fields.

Perhaps it was earlier a byway for local residents. However, between 1924 and 1930 the Downham Estate was developed by the London County Council and the Walk was incorporated into the plan as a footpath. The Walk is about 1.5 kilometres long and in most places it is only a few metres wide. Its total area is about 3.7 hectares. The Walk is currently in the London Borough of Lewisham, but was formerly in what was the parliamentary county Kent (vice-county 16, West Kent). A full description and history of Downham Woodland Walk will be found in the booklet *Nature conservation in Lewisham* (Archer and Yarham 2000). Today the path is tarmac, but either side a narrow strip of wooded land remains.

Nearby is another unusual woodland habitat in Lewisham — Forster Memorial Park — less than 200 metres north of the main stretch of the Woodland Walk. The 17-hectare park was part of the estate of the Forster family and was given to Lewisham to be laid out as a public space in 1919. It is thought to be the site of a double assart, a field cleared in woods, but with surrounding trees left to give shelter. Although the central grassland areas of the park are now short-mown playing fields, the surrounding woodland does show signs of being

ancient (Archer and Yarham 2000). Beckenham Place Park also contains remnants of ancient woodland in its 98 hectares (Archer and Yarham 2000). It is less than 500 metres south of the Woodland Walk.

An invertebrate survey of Downham Woodland Walk, carried out during 1999 (Jones 2000*a*), demonstrated the presence, in the Walk, of many unusual and interesting species. These included some insects particularly associated with ancient woodlands — those woods and copses thought to have been present before the sixteenth century — in particular specialist saproxylic beetles (those that breed in decaying wood). Species associated with dead wood are thought to require a continuous, uninterrupted supply of dead and decaying (fungoid) timber, and together they represent a truly relic community in a relic habitat. A follow-up survey to examine further the saproxylic beetles was commissioned in 2002 by the Friends of Downham Walk (Jones 2003). This paper is based on the survey work carried out during 1999 and 2002 and follows a similar paper on the beetles of Sydenham Hill and Dulwich Woods (Jones 2002*b*).

The surveys

The surveys included all of Downham Woodland Walk from Oakridge Road to Woodbank Road (Figure 1). For recording purposes, the Woodland Walk was divided into seven stretches, as shown on the sketch map. These compartments are:

A Oakridge Road to Haddington Road, grid reference TQ388716,

B Haddington Road to Oakshade Road, TQ391716,

C Oakshade Road to Downderry Road, TQ390719,

D Downderry Road to Moorside Road, TQ392720,

E 'Central reservation' between Shaw Road and Undershaw Road, TQ396721,

F Two small square 'central reservations' between Woodbank Road, Undershaw Road and Shaw Road, TQ397721, and

G 'Central reservation' running down Woodbank Road, TQ397722.

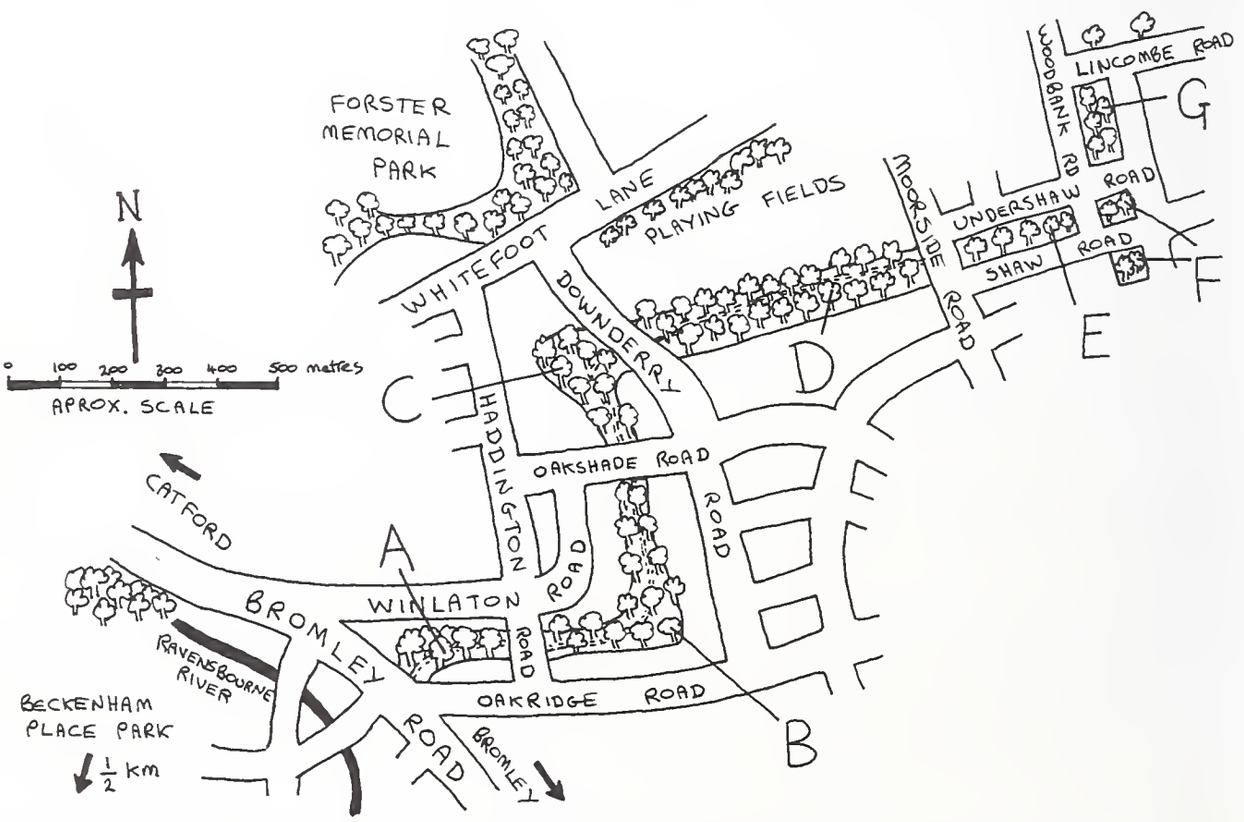

FIGURE 1. Diagramatic sketch map of Downham Woodland Walk. Note that the scale is only approximate.

The western part of the walk, areas A to D, is mostly bounded either side by the gardens of the local houses and is a path with trees, shrubs and undergrowth either side (Figure 2). When it emerges at Moorside Road (areas E to G), its character changes to that of a 'central reservation' between the roads. The trees are less old and the grass beneath them is regularly mown. In the strip bounding Woodbank Road there are many old hawthorn bushes, signs perhaps of a hedgerow here in former times (Figure 3). The Woodland Walk stops here, but there are a couple of old oak trees at the ends of gardens in Lincombe Road as it runs east.

FIGURE 2. View of Downham Woodland Walk, section B, photographed in May 1999.

FIGURE 3. View of Downham Woodland Walk, section G, the 'central reservation' running down Woodland Road, looking north towards Canary Wharf in the distance.

The beetles of Downham Woodland Walk

The invertebrate survey completed in 1999 (Jones 2000*a*) included a systematic list of 142 invertebrate species, of which 61 were beetles. The follow-up survey (Jones 2003) concentrated only on beetles and in particular those associated with dead-wood habitats. A systematic list of 111 species found in Woodland Walk is included here. Also included [in square brackets] are records from the nearby Forster Memorial Park (FMP) recorded by Jones (2000*b*). Rarity statuses are those given in the *Red Data Book* for insects (RDB2 'vulnerable', RDB3 'rare', RDBK 'rare but insufficiently known', Shirt 1987) and reviews of the British Coleoptera ('nationally scarce/notable categories A and B', Hyman and Parsons 1992, 1994). Provisional statuses are those given in the interim reports by Hyman (1985, 1986). Full criteria for according the various statuses are complex, but a summary is given in Jones (2002*b*).

Harding and Rose (H&R) grades and scores are measures of ancient woodland indicator status given by Harding and Rose (1986). They are further discussed below.

The saproxylic quality index (SQI) is based upon scores published by Fowles et al. (1999). It is further discussed below.

Species, ecological notes, dates and locations	Status	SQI	H & R grade	H & R score
Aderidae, fungus beetles				
Aderus oculatus (Payk.). Several specimens from under large dusty oak logs and by sweeping, C, D,19.vi.2002 and 2.vii.2002. It is found in dry dusty fungoid wood and is associated with ancient woodlands.	Nb	8	3	1
Anobiidae, woodworm beetles				
Anobium punctatum (Deg.). The common woodworm. It breeds in a variety of heart woods of many different tree species. B, C, D.	com	1	—	—
Dorcatoma chrysomelina Sturm. One beaten from oak branches, B, 10.vi.1999. This widespread, but very local species breeds in the rotten heart wood of old oak trees, especially in ancient woods. Although provisionally given nationally scarce (notable) status, this was not confirmed.	v loc	4	2	2
Hemicoelus fulvicornis (Sturm). Breeds in a wide variety of heart woods. A–E. [FMP]	com	1	—	—
Ochina ptinoides (Marsh.). This rather local beetle breeds in the dead stems of ivy *Hedera helix* usually requiring fairly large (and therefore old) stems. B. [FMP]	loc	2	—	—
Ptilinus pectinicornis (L.). Breeds in the heart wood of many broad-leaved trees, especially sycamore in the London area. A–C. [FMP]	loc	1	—	—
Stegobium paniceum (L.). Usually a domestic pest of stored foods and rarely found out of doors. Its 'original' habitat is likely to have been in animal nests feeding on spilled food. One beaten from ivy-covered tree trunk, C, 2.vii.2002.	com	—	—	—
Attelabidae, weevils				
Rhynchites aequatus (L.). On hawthorn leaves and blossom. G. [FMP]	com	—	—	—
Biphylidae, fungus beetles				
Biphylus lunatus (Fab.). Several found in *Daldinia* fungus on ash log, B, 24.vi.2002. Breeds solely in the 'cramp-ball' fungus *Daldinia concentrica*, and is associated with ancient woodlands. Not common in the London area.	local	4	3	1
Bruchidae, seed weevils				
Bruchus rufimanus Boh. On various leguminous plants. G.	com	—	—	—
Buprestidae, jewel beetles				
Agrilus laticornis (Ill.). One swept, D, 2.vii.2002. Breeds in oak logs and branches. Associated with old woodlands.	Nb	8	—	—
Agrilus pannonicus (Pill. & Mitt.). Many exit holes (some obviously recent, indicating new emergences, in both 1999 and 2002) found in several tree trunks, A–E, during 1999 and 2002. This very local species breeds in large dead oak	Na	8	2	2

Species, ecological notes, dates and locations	Status	SQI	H & R grade	H & R score
stumps and trunks and is associated with ancient pasture woods. It was previously regarded as being extremely scarce and was accorded red data book status 2 (vulnerable), but it appears to have enjoyed a rennaisance, especially after the destructive storms of the 1980s left many large oak stumps and logs. It is widespread, if very local, in the London area (Hackett 1995, Jones 1996).				
Agrilus sinuatus (Ol.). Many burrows and exit holes found, 1999 and 2002, A, B, D, G, especially in area G. The larvae bore characteristic winding (sinuous) burrows in the bark of dead hawthorn branches and trunks and leave characteristic D-shaped exit holes on their emergence. Although it was originally given red data book status 2 (vulnerable), this was revised when surveys showed that the exit holes and burrows were fairly widespread and that the elusive adults were rare and easily overlooked. It is associated with ancient hedges and old pasture woodland and is fairly widespread in the London area (Jones 1996). [Also recorded Forster Memorial Park, 1999.]	Na	4	—	—
Cantharidae, soldier beetles				
[*Cantharis lateralis* L. In woods, larvae predatory in rotten wood. FMP.]	[loc]	—	—	—
[*Cantharis rustica* Fall. Larvae predatory in wood or soil. FMP.]	[com]	—	—	—
Malthinus flaveolus (Herbst). Found in woodlands, larvae predatory in rotten wood. D.	com	1	—	—
Malthinus seriepunctatus Kiesenw. Woodlands, larvae predatory in rotten wood. D.	loc	2	—	—
Malthodes minimus (L.). Woodlands, larvae predatory in rotten wood. C. [FMP]	com	1	—	—
Carabidae, ground beetles				
Amara montivaga Sturm. One specimen found crawling under a log, D, 5.v.1999. This very local species occurs in dry soil areas, often near parks and gardens. Although provisionally given nationally scarce (notable B) status, this was not confirmed. It appears to be a recent arrival in Britain, and still spreading.	v loc	—	—	—
Bembidion guttula Fab. Clay soil, shady places. C.	com	—	—	—
Dromius quadrimaculatus (L.). Usually under loose tree bark. C, D.	com	—	—	—
Harpalus affinis Schr. Many habitats including parks and gardens. C.	com	—	—	—
Harpalus rufibarbis Fab. Various habitats including parks and gardens. B.	com	—	—	—
Nebria brevicornis (Fab.). Various habitats including woods, parks and gardens. D.	com	—	—	—
Pterostichus madidus (Fab.). Various habitats including woods, parks and gardens. D.	com	—	—	—
Cerambycidae, longhorn beetles				
Clytus arietis (L.). Larvae live in dead wood of various broad-leaved trees, adults fly readily, resembling wasps. C, D.	com	1	—	—
Grammoptera ruficornis (Fab.). Larvae feed in dead branches of various broad-leaved trees. Adults usually found at flowers, especially hawthorn. A, B, C, E, F. [FMP]	com	1	—	—
[*Leiopus nebulosus* (L.). Larvae in dead timber of various broad-leaved trees. FMP.]	[loc]	—	—	—
[*Leptura livida* Fab. Larvae in underground fungal growth. FMP.]	[loc]	—	—	—
Phymatodes testaceus (L.). One specimen under loose bark of a dead standing oak trunk, E, 5.v.1999. This widespread, but very local beetle breeds in various dead broad-leaved timbers throughout England and Wales. Although provisionally listed as nationally scarce (notable B), this was not confirmed.	v loc	4	3	1
Strangalia maculata (Poda). Larvae live in dead wood of various broad-leaved trees, adults fly readily and are usually seen visiting flowers. D.	com	1	—	—
Tetrops praeusta (L.). One beaten from hawthorn bush, G, 7.v.2002. Breeds in the branches of various broad-leaved trees, including fruit trees and hawthorn.	loc	2	—	—
[Cerylonidae, fungus beetles**]**				
[*Cerylon ferrugineum* Steph. Under fungoid bark of broad-leaved trees. FMP.]	[loc]	—	—	—
Chrysomelidae, leaf beetles				
Chalcoides plutus (Latr.). On leaves of willows, sallows, poplars etc. C.	loc	—	—	—
Chrysolina oricalcia (Müll.). One swept from herbage, B, 16.vi.1999. This widespread, but rather local species is associated with cow parsley *Anthriscus sylvestris* in woodlands, hedges, and wet grassland. [Also recorded from Forster Memorial Park, 27.v.1999.]	Nb	—	—	—

Species, ecological notes, dates and locations	Status	SQI	H & R grade	H & R score
Lamprosoma concolor (Sturm). Woodlands, sweeping or in moss. B, D. [FMP]	loc	—	—	—
Psylliodes chrysocephala (L.). Feeds on various crucifers. C.	com	—	—	—
Ciidae, fungus beetles				
Cis boleti (Scop.). In bracket fungus on trunks and logs. B.	com	1	—	—
Coccinellidae, ladybirds				
Adalia bipunctata (L.). Two-spot ladybird. Predatory, wide variety of habitats. A, B, D.	com	—	—	—
Adalia decempunctata (L.). Ten-spot ladybird. Predatory, wide variety of habitats. A–D.	com	—	—	—
Calvia 14-guttata (L.). Cream-spot ladybird. Variety of habitats. B.	com	—	—	—
Coccinella septempunctata L. Seven-spot ladybird, wide variety of habitats. B.	com	—	—	—
Exochomus 4-pustulatus (L.). 'Pine' laybird. On broad-leaved trees also, eats scale insects. B, C.	com	—	—	—
Halyzia sedecimguttata (L.). Orange ladybird. Feeds on mildews, especially on sycamore trees. Once regarded as rare, now known to be widespread, at least in central and southern England. B, D.	local	—	—	—
Nephus quadrimaculatus (Herbst). One specimen, beaten from ivy-covered log, G, 2.v.2002. Once thought to be extremely rare, it has recently been found in several Surrey localities (Hawkins 2000). It seems to be associated with ivy and may be predatory on coccids feeding on this plant. Its rarity status may need to be revised, but it remains a very scarce species.	RDB2	—	—	—
Propylea 14-punctata (L.). Fourteen-spot ladybird. Predatory, wide variety of habitats. D.	com	—	—	—
Psyllobora 22-punctata (L.). 22-spot ladybird. Mildew-feeder, variety of habitats. A.	com	—	—	—
Rhyzobius chrysomeloides (Herbst). On specimen beaten from hawthorn, and ivy-covered log, G, 7.v.2002. This beetle was first found in Britain in Surrey in 1996 (Hawkins, 2001). It has been found at a few other localities in Surrey (Hawkins 2000) and in Berkshire (R. Booth, pers.comm.). This is the first record of this beetle for south-east London or the vice-county of West Kent.	v loc	—	—	—
Subcoccinella 24-punctata (L.). 24-spot ladybird, feeds on false oat grass. A.	com	—	—	—
Colydiidae, fungus beetles				
Bitoma crenata (Fab.). Several specimens found under fungoid bark, D, 5.v.1999. This is a widespread, but uncommon species found under fungoid bark. It is particularly associated with ancient woods.	loc	4	3	1
Curculionidae, weevils				
Anthonomus pedicularius (L.). Feeds on hawthorn. D, G.	com	—	—	—
Barypeithes pellucidus (Boh.). In leaf litter, under logs etc. C–E. [FMP]	com	—	—	—
Curculio glandium Marsh. On oaks. Larvae develop in the acorns. D–F. [FMP]	loc	—	—	—
Curculio pyrrhoceras Marsh. On oaks. Larvae develop in the acorns. B, C.	loc	—	—	—
Dorytomus ictor (Herbst). Several specimens found under the loose bark of a large black poplar tree, G, 5.v.1999. This widespread, but very local beetle feeds on the leaves of black poplar (*Populus nigra* and *P.* × *canadensis* and other cultivars). It is especially associated with large mature trees, where it can overwinter in crevices and under loose bark. It occurs at several London sites, usually on trees planted in parks and ornamental gardens.	Nb	—	—	—
[*Dorytomus melanophthalmus* (Payk.). On poplars. FMP.]	[loc]	—	—	—
Euophryum confine (Br.). Breeds in moist and dry dead wood usually in broad-leaved species in the 'wild' but also attacks soft-wood timber in houses where damp has caused rot. Originally a native of New Zealand, this species has spread until it is widespread and common throughout Britain. C, F. [FMP]	com	—	—	—
Magdalis armigera (Geoff.). Several specimens swept beneath elms B, 20.v.1999, and beaten from elm trees, D, 7.v.2002. This widespread, but very local species breeds in the twigs and branches of elm trees. It is currently increasing in elm sucker regrowth, after becoming extremely scarce following the disappearance of elm trees from the landscape after the ravages of Dutch elm disease in the 1970s. [Also recorded from Forster Memorial Park, 17.vi.1999.]	v loc	2	—	—

Species, ecological notes, dates and locations	Status	SQI	H & R grade	H & R score
Phloeophagus lignarius (Marsh.). In rotten wood of broad-leaved trees. D.	loc	2	—	—
Polydrusus pilosus Gred. Feeds on the leaves of a variety of broad-leaved trees. C–E. [FMP]	loc	—	—	—
Rhinonchus pericarpius (L.). Feeds on the leaves of various *Rumex* species. B–D.	com	—	—	—
Dermestidae, museum, hide and larder beetles				
Anthrenus verbasci (L.). The museum beetle. Indoors in kitchens, carpets, museum specimens etc; outdoors on flowers. B–D.	com	—	—	—
Attagenus pelio (L.). Larvae in nests, stored food, furs and hides, adults at flowers. E.	loc	—	—	—
Ctesias serra (Fab.). Larvae found under loose bark, C, 7.v.2002. The larvae live under bark, in spider webs, feeding on the insect remains of the spiders' prey. They avoid being eaten themselves because they are covered in thick bristles. [Also recorded from Forster Memorial Park, 17.vi.1999.]	Nb	4	3	1
Elateridae, click beetles				
[*Athous campyloides* Newm. At grass roots. Recorded from Forster Memorial Park, sweeping, 17.vi.1999.]	[Nb]	—	—	—
Athous haemorrhoidalis (Fab.). Larvae in dead wood of broad-leaved trees. B–D. [FMP]	com	—	—	—
Cidnopus minutus (L.). Larvae in grass roots, rotten wood etc. D. [FMP]	com	—	—	—
Dallopius marginatus (L.). Larvae in grass roots, rotten wood etc. D.	com	—	—	—
Steganostus rhombeus (Ol.). Part of a dead specimen (elytra) was found under rotten oak bark, B, 5.v.1999. This is a local, but widespread species which breeds in the dead timber of broad-leaved trees. Although provisionally listed as nationally scarce (notable B), this was not confirmed.	v loc	4	3	1
Erotylidae, fungus beetles				
Dacne bipustulata (Thunb.). Breeds in rotten wood and fungus. D.	loc	2	—	—
Histeridae, scavenger beetles				
Paromalus flavicornis (Herbst). Under fungoid bark of broad-leaved trees. D.	com	2	—	—
Hydrophilidae, scavenger beetles				
Cryptopleurum minutum (Fab.). In decaying organic matter (dung, grass cuttings etc.). D.	com	—	—	—
Megasternum obscurum (Marsh.). In decaying organic matter (dung, grass cuttings etc. D.	com	—	—	—
Lathridiidae, mould beetles				
Aridius bifasciatus (Reit.). Feeds on mould in decaying vegetable matter. Although a native of New Zealand and only discovered in the UK in the early 1950s, it is now very widespread and common. B–D.	v com	—	—	—
Corticarina fuscula (Gyl.). Feeds on mould in decaying vegetable matter. C.	com	—	—	—
Cortinicara gibbosa (Herbst). Feeds on mould in decaying vegetable matter. G.	com	—	—	—
Enicmus histrio Joy & Tomlin. In vegetable refuse, grass cuttings etc. D.	loc	—	—	—
Enicmus testaceus (Steph.). Many specimens swept, C, D, 7.v.2002 and 19.vi.2002. Usually found in powdery fungus on trees. Although provisionally suggested as being nationally scarce this was not confirmed.	v loc	2		
Enicmus transversus (Ol.). Feeds on mould in decaying vegetable matter. D.	com	—	—	—
Lucanidae, stag beetles				
Dorcus parallelipipedus (L.). The lesser stag beetle. This common species breeds in rotten wood of various broad-leaved trees, usually logs and stumps. B–D.	com	2	—	—
Lucanus cervus (L.). The stag beetle. Many specimens, males and females found throughout areas C and D, 20.v.1999, 10.vi.1999 and 25.viii.1999. Several dead specimens were found 7.v.2002 and 24.vi.2002 and larvae on 24.vi.2002. Although common and widespread in south-east London, this species is very local and thought to be declining nationally. It breeds in dead heart wood of broad-leaved trees, especially in large logs and in roots and partially subterranean wood such as old stumps and large logs lying in the soil. In south London it is essentially a garden species. [A large number of broken remains of stag beetles, thought to have been killed by mowing machinery, were also found in Forster Memorial Park, 17.vi.1999 (Jones 2002*a*).]	Nb	8	—	—

Species, ecological notes, dates and locations	Status	SQI	H & R grade	H & R score
Melandryidae, fungus beetles				
Abdera quadrifasciata (Curt.). One found crawling on log, D, 22.vii.1999. A widespread, but very local species found in fungus and fungoid bark of various broad-leaved trees. [Another specimen was also found in Forster Memorial Park, 17.vi.1999.]	Na	16	1	3
Phloiotrya vaudoueri Muls. One found under fungoid bark, D, 10.vi.1999. This widespread, but very local species is found in ancient woodlands in England. It breeds in fungoid bark of broad-leaved trees.	Nb	8	2	2
Melyridae, false soldier beetles				
Axinotarsus marginalis (Lap.). Various habitats, larvae predatory, probably in rotten wood or soil. Although only recognized as a British species in 1971, it is now known to be common and widespread. C, D. [FMP]	com	—	—	—
Malachius bipustulatus (L.). Various woodland habitats, larvae predatory, in rotten wood or soil. D.	com	1	—	—
[*Malachius viridis* Fab. Larvae predatory in grass roots. FMP.]	[com]	—	—	—
Mordellidae, flower beetles				
Mordellistena humeralis (L.). One specimen swept from herbage, C, 23.viii.1999. This very local species is probably under-recorded. The larvae breed in dead wood, but the adults are found on flowers.	RDBK	—	—	—
Mordellistena variegata (Fab.). One specimen swept from herbage, 16.vi.1999, others taken 2.vii.2002, C, D. This very local, but widespread species is associated with woodland. Although provisionally listed as nationally scarce (Nb), this was not confirmed. [Also recorded from Forster Memorial Park, 17.vi.1999.]	v loc	8	—	—
Mycetophagidae, fungus beetles				
Litargus connexus (Fourc.). Under fungoid wood of broad-leaved trees. C.	loc	2	—	—
Mycetophagus quadripustulatus (L.). Breeds under fungoid bark, especially in old woodlands. D.	loc	2	—	—
Nitidulidae, fungus beetles				
Epuraea aestiva (L.). In fungus, under fungoid bark. D, G.	com	—	—	—
Oedemeridae, flower beetles				
Oedemera lurida (Marsh.). On flowers, leaves etc. C.	com	—	—	—
Platypodidae, bark beetles				
Platypus cylindrus (Fab.). Many specimens found boring into a dead oak, D, 23.viii.1999. So many of these beetles had recently attacked the trunk, that sawdust cascaded down the bark of the stump. This widespread, but rather local species attacks dead oak trunks, logs and stumps, particularly in ancient woodland. Although originally given red data book 3 (rare) status, this was revised when it was discovered to be more widespread.	Nb	8	3	1
[Rhipiphoridae, scavenger beetles**]**				
[*Metoecus paradoxus* (L.). Breeds in the nests of social wasps *Vespula*. Recorded from Forster Memorial Park, on old tree trunk, 30.ix.1999.]	[v loc]	—	—	—
Salpingidae, fungus beetles				
Lissodema quadripustulata (Marsh.). Several specimens swept, B, C, D, 19.vi.2002 and 2.vii.2002, including a dead specimen beaten from ivy thicket on half-fallen tree trunk. Under fungoid bark, broad-leaved trees.	Nb	8	—	—
Rhinosimus planirostris (Fab.). Under fungoid bark, broad-leaved trees B, D. [FMP]	loc	1	—	—
Scolytidae, bark beetles				
Dryocoetinus villosus (Fab.). In the bark of various broad-leaved trees. D.	loc	2	—	—
[*Hylesinus crenatus* (Fab.). In bark of ash and other trees. FMP.]	[loc]	—	—	—
Hylesinus oleiperda (Fab.). Breeds in the bark of ash trees. C. [FMP]	loc	2	—	—
Leperisinus varius (Fab.). Breeds in the bark of ash and elm trees. D.	loc	1	—	—
Scolytus multistriatus (Marsh.). On elm. Burrows under bark, leaving characteristic tunnels. This is one of the species known to spread Dutch elm disease. Pupae and tunnels found, B, D, E. [FMP]	com	1	—	—

Species, ecological notes, dates and locations	Status	SQI	H & R grade	H & R score
Scolytus pygmaeus (Fab.). One specimen by beating elm branches, C, 2.vii.2002. Breeds in the bark of elm trees. A recent colonist to Britain, first discovered in 2001 at Darenth, Kent (Heal, in prep.) and subsequently found in Basildon, Essex (R.A. Jones, unpublished record) and in Ikenham Fen, Middlesex (C.W. Plant, pers.comm.). On the Continent, it is known as one of the species which can spread Dutch elm disease.	v loc	—	—	—
[*Scolytus rugulosus* (Müll.). On hawthorn and fruit trees. Recorded from Forster Memorial Park, 1999.]	[loc]	—	—	—
Scolytus scolytus (Fab.). On elm. Burrows under bark, leaving characteristic tunnels. This is one of the species known to spread Dutch elm disease. Burrows, A, B.	com	2	—	—
Xyleborus saxeseni (Ratz.). Several specimens were found in rotten oak oak bark, D, 23.viii.1999. This very local, but widespread species breeds in the bark of oak trees in ancient woodlands. Although provisionally listed as nationally scarce (B), this was not confirmed.	v loc	4	3	1
Scraptiidae, flower beetles				
Anaspis humeralis (Fab.). Adults on flowers, larvae in rotten wood. B, D. [FMP]	com	2	—	—
Anaspis maculata Fourc. Adults on flowers, larvae in rotten wood. B, C.	com	—	—	—
Anaspis regimbarti Schil. Adults on flowers, larvae in rotten wood. B–E, G.	com	—	—	—
Scydmaenidae, fungus beetles				
Stenichnus collaris Müller & Kunze. In moss and grass roots. C.	com	—	—	—
Staphylinidae, rove beetles				
Cypha longicornis (Paykull). In leaf litter, vegetable refuse etc. D, G.	com	—	—	—
Gabrius splendidulus (Grav.). This common beetle lives under rotten bark of various tree species. D.	com	1	—	—
Gyrohypnus punctulatus Payk. Grassy places. D.	loc	—	—	—
Philonthus fimetarius (Grav.). In decaying organic matter. B.	com	—	—	—
Quedius tristis (Grav.). In decaying organic matter. D.	com	—	—	—
Staphylinus ater (Grav.). Under stones, logs etc. D.	com	—	—	—
Staphylinus compressus Marsh. Under stones, logs etc. D.	loc	—	—	—
Staphylinus olens Müller. Under stones, logs etc. D.	com	—	—	—
Sunius propinquus (Bris.). In decaying vegetable matter. D.	com	—	—	—
Tachyporus hypnorum (Fab.). Grassy places. C.	com	—	—	—
Tenebrionidae, darkling beetles				
Cylindronotus laevioctostriatus (Goeze). Under fungoid bark. D. [FMP]	loc	—	—	—
Prionychus ater (Fab.). Several specimens found under loose oak bark, B, 2.vii.2002. Breeds in rotten timber in ancient woods.	Nb	8	3	1
Throscidae, lesser click beetles				
Trixagus carinifrons (de Bonv.). In dead wood. D.	loc	—	—	—

Total 'Harding and Rose' score:	18	(13 spp.)
Total saproxylic quality score:	164	
Number of qualifying species:	47	
Saproxylic quality index (164 / 47 × 100):	348.94	

Discussion

Not surprisingly, many of the beetles were those often found in woods and gardens in and around London. However, there were also many which are nationally rare (*Red Data Book* status) and nationally scarce (notable). The list includes some that are well known to be specifically associated with ancient woodland and pasture-woodland and recognized as 'indicator' species by Harding and Rose (1986). They grouped these beetles into three classes:

- ***Group 1***. Species which are known to have occurred in recent times only in areas believed to be ancient woodland, mainly pasture-woodland.
- ***Group 2***. Species which occur mainly in areas believed to be ancient woodland with abundant dead-wood habitats, but which also appear to have been recorded from areas that may not be ancient or for which the locality data are imprecise.
- ***Group 3***. Species which occur widely in wooded land, but which are collectively characteristic of ancient woodland with dead-wood habitats.

Thirteen of these 'indicator' beetle species (1 from group 1, 3 from group 2 and 9 from group 3) were recorded from Downham Woodland Walk. This compares to 17 found in Sydenham Hill and Dulwich Woods (Jones 2002*b*).

Ancient woodlands have received quite some considerable attention from ecologists, and following the publication of lists of 'indicator' species by Harding and Rose (1986), others have attempted to compare and contrast sites by constructing scores and indices based upon these lists. For example, Alexander (1988) and Harding and Alexander (1994) suggested scores for the 'indicator' beetle species listed by Harding and Rose (1986), those most linked to ancient woodland scoring higher than those only collectively associated, thus:

Harding and Rose group	Alexander score
Group 1	3
Group 2	2
Group 3	1

Examining species lists from various sites enabled Harding and Alexander (1994) to prepare a table of species scores, the so-called index of ecological continuity, for well-known ancient woodland sites in Britain. Large and well-studied ancient woods scored very highly — Windsor Forest with 233, New Forest with 183 and Moccas Park with 129, these being Britain's top three sites. However, most ancient woods scored much lower (Harewood Forest 22, Nettlecombe Park 23, Bookham Common 20, Ashtead Common 33, etc.), and an index value of 20 appeared to identify the most important sites in a national series studied by Alexander (1995).

At the end of the follow-up survey, the number of 'indicator' species for Downham Woodland Walk was 13, and the index of ecological continuity 18, a respectable count given the Woodland Walk's extremely small size, and the marvel that it survived the urban building boom of the 1920s.

Further interest in saproxylic species (those breeding in rotten wood) has produced more work, in particular on beetles, one of the groups of insects most strongly associated with old woods. Fowles (1997) discussed the rationale behind establishing a new system of scoring woods, based on species rarity scores, and he sought to establish a wider base of saproxylic species upon which scoring could be calculated. Fowles et al. (1999) gave a much longer list of 599 beetle species than Harding and Rose's (1986) limited list if 196 species, and included

common saproxylic species as well as the scarcer 'indicator' species. They suggested a scoring system based upon national scarcity as follows:

Score	Status
1	common
2	local
4	very local/uncertain
8	nationally scarce (notable B)
16	nationally scarce (notable A)/RDBK (insufficiently known)
24	RDBI (indeterminate)/ RDB3 (nationally rare)
32	RDB1 (endangered)/ RDB2 (vulnerable)/ RDB appendix (extinct)

Fowles et al. (1999) tested the reliability of these scores against 126 species lists from various woodland localities across Great Britain, and satisfied themselves, and other colleagues, that the scheme had value in comparing and contrasting woods in terms of the quality of their dead-wood beetle faunas. A minimum threshold of 40 qualifying species was thought sufficient to ensure that unreliable (short and therefore unrepresentative) lists could be excluded. To overcome the bias of recording effort, especially at well-known and oft-visited sites, they suggested the calculation of a 'saproxylic quality index' (SQI), as well as a 'total saproxylic quality score'. This was achieved by dividing the total score by the number of qualifying species and multiplying by 100.

This calculation applied to Downham Woodland Walk is done in the species list. Here it is demonstrated that 47 qualifying species achieved a total score of 164, giving a saproxylic quality index of 348.9.

Again, not surprisingly, Britain's top sites had huge scores. Windsor Forest, for example, produced a list of 365 qualifying species, a total score of 3,092 and an index of 847.1. Fowles et al. (1999) suggest a saprozylic quality index approaching 600 could denote a site of international importance (they give 7 UK sites) and an index over 500 could denote a site of national importance (a further 8 UK sites listed). They also give a list of 42 other British sites with scores ranging from 488.7 to 236.6.

Recent work has led to the publication (on the internet) of up-to-date SQIs for Britain's top-scoring 100 woods (http://thasos.users.btopenworld.com/sqi.htm). Presently (site updated 21 December 2002) the New Forest is ranked top with 326 species, a total score of 2,792 and an SQI of 856.4; Windsor has 364 species, a total score of 3,084 and an SQI of 847.3. Sydenham Hill and Dulwich Woods in Southwark (vice-county 17, Surrey, was ranked 29th with 53 species, a total score of 229 and an SQI of 430.1).

At its current index of 348.9, Downham Woodland Walk is ranked a very respectable 52nd in the list of 100 UK woods and is confirmed as a very important locality, in both local and national contexts, by virtue of its dead-wood beetle fauna.

Conclusion

Downham Woodland Walk's survival during the large-scale house building of the first half of the twentieth century is a wonder, the more so because of the fascinating insect fauna it contains. The Woodland Walk has a rich fauna of dead-wood beetles, including several acknowledged 'indicator' species that highlight the woods as a site of great importance.

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identification of *Rhyzobius chrysomeloides* and Maxwell Barclay lent me specimens of *Scolytus pygmaeus* from the Natural History Museum to confirm its identity. Adrian Fowles commented on and checked the saproxylic quality index calculations.

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The larger Brachycera, Syrphidae and Conopidae (Diptera) of Mitcham Common

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Abstract

Mitcham Common is one of the better-known invertebrate sites in south London. Its Diptera fauna has been studied by a number of recorders for more than fifty years but there are few published accounts. This note draws together the data for the soldierflies and their allies, the hoverflies, and the Conopidae, and compares them with published lists for other sites in the London Natural History Society recording area. Records of other Diptera families collected incidentally to the main focus of attention are listed, but are not evaluated in detail.

Introduction

Mitcham Common is well known for its Lepidoptera (Morris 1984) and Hymenoptera faunas (Morris 1997). There is also a very substantial list of the Hemiptera–Heteroptera in an unpublished report by Hollier (1984). It is one of the most important dry grass heath sites in south London, and although not identified as nationally important within the SSSI series designated by English Nature, there are components of its fauna that make it unusual and, in a London context, special.

Although it is a site that has attracted much attention over the last fifty years, initially by the late Len Parmenter until the 1960s, by Alan Stubbs in the 1960s and 1970s and by myself in the 1980s and 1990s, the Diptera interest is poorly documented. Even so, it has yielded a number of unusual records and was the first locality from which the hoverfly *Epistrophe melanostoma* was reported as British (Beuk 1990). The majority of records in this account derive from active fieldwork, but a small number arise from a programme of water-trapping described by Morris (1997).

This account discusses those species covered by the recently published account of soldierflies and their allies (Stubbs and Drake 2001), the hoverflies, and the Conopidae, that together form the bulk of the most popular Diptera. The nomenclature follows Chandler (1998) and published updates in *Dipterists Digest* that are adopted by Stubbs and Drake (2001) and the recently revised Stubbs and Falk (2002). Also included as an appendix are those species representing other families that have been recorded during the course of fieldwork but have been given insufficient attention to merit any detailed analysis.

Context

In both a London and Surrey context, there are very few published accounts of Diptera, including comprehensive site lists, against which Mitcham Common

can be compared. Great Bookham Common is well recorded (Parmenter 1950*a*, 1960, 1966), and Limpsfield Common has a published list (Parmenter 1942) but is relatively unknown. The few published lists for the London area include studies of Cripplegate bomb sites (Parmenter 1953, 1968), surveys of Buckingham Palace Garden (Richards 1964, Plant 2001) and a list for Epping Forest (Hanson 1985). A comparative table for representation of individual families at Mitcham, Great Bookham and Limpsfield Commons, and Epping Forest is given in Table 1. From this it can be seen that Mitcham Common supports not dissimilar numbers of species in most families in comparison with Great Bookham Common and Epping Forest, but the total faunas of the latter two are richer, largely because of their exceptional hoverfly faunas.

The differences in the faunas of these four sites arise partly from recorder effort, but also because there is substantial variation in the geology of each site and the habitats they support. Mitcham Common comprises 440 acres (183 hectares) of gravels overlying London Clay; it supports scrubby grass heath and dry woodlands dominated by oak and hawthorn. There are a series of ponds of varying size, arising from gravel extraction in the nineteenth century. Limpsfield Common lies on the Greensand, and supports grass heath with more extensive *Calluna* heath, together with drier woodlands, and might be expected to support a not dissimilar fauna to Mitcham Common given the same degree of recorder effort. Great Bookham Common lies on London Clay and comprises a mosaic of mesotrophic grasslands, a series of ponds, and oak woodland with some conifers. Epping Forest lies on London Clay with overlying gravels, sands and pebble beds. It is a mixture of pasture woodland combined with a mosaic of grassland, heathland, bogs and ponds, covering some 6,000 acres (2,500 hectares).

Results

A total of 141 species within the larger Brachycera, Syrphidae and Conopidae have been recorded, including a number of species that have not been noted in the past twenty-five years. Records for each family represented on Mitcham Common are discussed separately. They are compared against published lists for Great Bookham and Limpsfield Commons, and for Epping Forest and against lists for better recorded sites in Surrey recorded as part of the development of the Surrey Atlas Project (Morris 2002).

RHAGIONIDAE

Species recorded: *Chrysopilus cristatus*, *Rhagio lineola*, *Rhagio tringarius.*

The strongly acidic, dry habitats of Mitcham Common do not favour the Rhagionidae, a family that includes specialists associated with calcareous habitats, damp woodlands and wooded rivers. Few additional species might be anticipated, save for *Rhagio scolopaceus*, which is widespread in Surrey and might be expected to occur on Mitcham Common.

TABANIDAE

Species recorded: *Haematopota crassicornis.*

The horseflies are a family that largely favour damp grasslands, water meadows and coastal grazing marshes. The presence of just a single species is therefore unsurprising, although *Haematopota crassicornis* is considerably scarcer in Surrey than *H. pluvialis* and seems to favour more acidic sites (Morris 2000)

XYLOMYIIDAE

Species recorded: *Solva marginata.*

These flies are associated with rotting timber and rot holes. *Solva marginata*, listed as Nationally Scarce in Falk (1991), is the only species that might be

STRATIOMYIDAE

Species recorded: *Beris chalybata*, *B. geniculata*, *B. morrisii*, *B. vallata*, *Chorisops nagatomii*, *C. tibialis*, *Pachygaster atra*, *P. leachii*, *Chloromyia formosa*, *Microchrysa flavicornis*, *M. polita*, *Sargus bipunctatus*, *Odontomyia ornata*, *Odontomyia tigrina*, *Stratiomys potamida*, *S. singularior.*

These are the soldierflies, a group of handsome metallic or brightly coloured species, many of which are associated with wetlands. The majority of the species represented on Mitcham Common are associated with damp soils and leaf litter, but there are four species of note. *Odontomyia ornata* (*RDB2*) is known from an old record reported by Shirt (1987) and is a mainly coastal species that cannot be expected to be resident today. The remaining three are believed to be resident: *Odontomyia tigrina* (Nationally Scarce) is closely associated with wetlands with rich marginal vegetation, and was recorded from the vegetation-choked tributary of the River Wandle at Goat Green. The two *Stratiomys* species are likely to be found in the muddy margins of ponds and ditches. *Stratiomys potamida* (Nationally Scarce) was formerly regarded as a scarce species but has recently become much more abundant. *S. singularior* (Nationally Scarce) is usually found in coastal locations, yet there is a very good historic record of this species on Mitcham Common and on the adjacent Beddington Sewage Farm (Morris 2000), suggesting that there is a well-established and robust population.

ACROCERIDAE

Species recorded: *Paracrocera orbiculus*, *Ogcodes gibbosus.*

These are dumpy little spider parasites and are rarely recorded but are possibly commoner than records suggest. They seem to be more frequently encountered in dry habitats and thus the presence of two species on Mitcham Common is not surprising. *Ogcodes gibbosus* is listed as Nationally Scarce by Falk (1991) who reports the single record in 1975 from Mitcham Common.

BOMBYLIIDAE

Species recorded: *Bombylius major.*

There are very few common beeflies, only one of which is ubiquitous. The remaining members of this family are largely specialists, associated with sand dunes and heathlands. Thus the presence of the one ubiquitous species is unsurprising.

THEREVIDAE

Species recorded: *Thereva bipunctata*, *T. nobilitata.*

The larvae of the stiletto flies are mostly associated with loose sandy sites such as sand dunes, friable riverbanks and some heathland. Thus there are few possible additions that might be expected. *Thereva nobilitata* is a widespread across Surrey, whereas *T. bipunctata*, which was recorded by Len Parmenter (diary entry), is seemingly associated with drier heathland sites.

ASILIDAE

Species recorded: *Asilus crabroniformis*, *Dysmachus trigonus*, *Machimus atricapillus*, *M. cingulatus*, *Leptogaster cylindrica*, *Dioctria atricapilla*, *D. baumhaueri*, *D. rufipes.*

Hot dry sites such as Mitcham Common often support a rich robberfly fauna amongst those species that favour sandy well-drained conditions. The known fauna of Mitcham Common largely comprises grassland species. It includes a surprising record of *Asilus crabroniformis* (Nationally Scarce) reported by David Lees (29.viii.1991) which may represent a vagrant rather than a resident population, as this is a large, readily identifiable species that would have been noted by other recorders.

SYRPHIDAE

Table 2 lists the hundred species recorded from Mitcham Common as defined on the map given in Morris (1997). Not included in this total are three species, *Eupeodes nielseni*, *E. latilunulatus*, and *Cheilosia antiqua* reported in by Dunn and Johnson (1984). I have checked specimens of species that I considered doubtful and have discounted the records of these three species upon further examination. Thus the list of fifty-four species reported in that work should be revised down to fifty-one species.

In order to place the Mitcham Common fauna into context, Table 3 provides a breakdown of the assemblages of hoverflies represented at some of the best-recorded sites in Surrey (taken from the Surrey Hoverfly database) and within the London Natural History Society recording area. This provides a clear illustration of the range of representation at different sites. On Mitcham Common the aphidophagous species amongst the Bacchini, Syrphini and Pipizini are particularly well represented, together with associates of social Hymenoptera within the genera *Chrysotoxum*, *Xanthogramma* and *Volucella*. Wetland specialists are poorly represented, with just one noteworthy species *Anasimyia transfuga*. Similarly, stem and root borers are less well represented than for example, on Great Bookham Common and Box Hill, reflecting the hot dry nature of Mitcham Common and the lack of calcareous influences experienced by sites that overlie the London Clay and the Chalk.

The lack of wetland specialists may arise for a variety of reasons, especially the loss of small ponds and boggy areas as a result of infilling over the past hundred years. Some remnants of the possibly once rich fauna are illustrated by the small selection of species recorded from the banks of the River Wandle at Goat Green. Nearby, Cranmer Pond might reasonably be considered part of the Mitcham Common. This pond is rarely visited and as a consequence retains rich marginal and emergent vegetation that does not occur elsewhere on the Common. Three species, *Platycheirus fulviventris*, *Anasimyia contracta* and *Parhelophilus versicolor*, noted here might reasonably have been expected to occur more widely in the past. These observations illustrate the impact that visitor pressure can have on the plants and animals of urban water-bodies where trampling can effectively eradicate marginal vegetation and its associated fauna.

There are two ubiquitous saproxylic species: *Myathropa florea* and *Xylota segnis*, both of which are likely to be found at most sites and are not indicative of high-quality habitat. *Chalcosyrphus nemorum* is locally common and has been noted on Mitcham Common in association with rotting black poplar *Populus nigra* var. *serotina* trunks and roots. *Brachyopa insensilis* is listed as Nationally Scarce and is associated with sap runs on horse chestnut, a popular introduction to urban areas. Thus, neither *C. nemorum* nor *B. insensilis* can be regarded as native to the Common. It is quite possible that *Xylota sylvarum* is also associated with decaying poplar timber, having been recorded close to similar habitat.

Amongst the most noteworthy species listed are *Epistrophe melanostoma*, a recent addition to the British fauna and one that is still principally known from Surrey although it is known from a few other southern counties (Ball and Morris 2000). *Meligramma trianguliferum* (Nationally Scarce) is thinly scattered across Surrey (Morris 1998), and is known from two specimens taken on Mitcham Common in 1989 and 1990. *Triglyphus primus* (Nationally Scarce) is associated with aphids on mugwort *Artemisia vulgaris* and is rarely encountered: in my time recording it was only noted on three occasions (7.v.1989, P.L. Th. Beuk, 27 and 28.viii.1990, RKAM) when it was abundant at wild parsnip *Pastinaca sativa*. *Pipizella virens* (Nationally Scarce) is known from just four specimens (v.1975, A.E. Stubbs, 18 and 23.vii.1988, 28.viii.1991, RKAM). Other Nationally Scarce species that occur widely on Mitcham Common include *Didea fasciata*, a species that is widespread in Surrey and often occurs on scrubby sites; whilst both *Volucella inanis* and *V. zonaria* are common in certain years, often occurring in numbers on Michaelmas daisy *Aster novi-belgii*.

A number of Nationally Scarce species are known from single records. *Epistrophe diaphana* is listed on the former Nature Conservancy Council's Invertebrate Site Register as having been taken between 1971 and 1974 by Alan Stubbs. Len Parmenter (data on duplicate record cards held by Alan Stubbs) recorded *Meligramma guttatum*, on 6.vi.1949, and *Cheilosia carbonaria* on 16.viii.1959. *C. velutina*, a species that is very difficult to identify and possibly confused with *C. proxima*, was taken by me on 23.vii.1988.

The survey by Dunn and Johnson (1984) gave an indication of the relative species-richness of the various sub-sites of the Common. This survey strongly favoured the Seven Islands Pond site and the relative interest of the various sub-sites is probably influenced by recorder effort. Using more recent data, the variations between sites are less pronounced (Tables 2 and 5). It is clear, however, that the levels of survey are very uneven, with numerous widespread species missing from the lists for various sub-sites. More detailed recording is likely to reduce these differences considerably.

Although a hundred species appears to be a considerable list of hoverflies, there are few sites as intensively recorded as Mitcham Common, either in Surrey, London or elsewhere in the UK. It is very probable that this is not an unusually large fauna, as Great Bookham Common and Epping Forest show. In a Greater London context, however, a list of this size is probably typical for sites of similar area that support a mixture of dry acid grassland, woodland and wetland habitats.

CONOPIDAE

Species recorded: *Conops ceriaeformis*, *C. quadrifasciatus*, *Leopoldius signatus*, *Physocephala rufipes*, *Myopa testacea*, *Sicus abdominalis*, *S. ferrugineus.*

The Conopidae are parasites of solitary and social bees and wasps, and may be found in association with bee and wasp colonies, as well as on flower heads. They are often brightly coloured and are therefore one of the more popular families of Diptera collected by dipterists and general natural historians. The presence of a relatively rich Hymenoptera fauna might be expected to result in a rich Conopidae fauna. Unfortunately there are few sites against which the Mitcham Common list can be adequately compared, and it is difficult to establish how unusual the assemblage is. Table 4 compares those sites for which there are species lists of a similar or greater size for sites in Surrey and Greater London. It shows clearly the immense variation in the assemblage, and suggests that there are possible additions to be found on Mitcham Common amongst the genera *Conops* and *Myopa*.

Sicus abdominalis (6.vii.1991, RKAM) listed in Falk (1991) as *Red Data Book* **1**, and still known from just a handful of British records, is the most interesting species noted. It is a parasite of bumblebees, but its precise host is not known. Also of note is *Leopoldius signatus*, a social wasp parasite that occurs at ivy *Hedera helix* in autumn and is well established at sites in the vicinity of Mitcham Common. It is possible that further species will be added, perhaps including *Thecophora atra*, which has been recorded nearby in Carshalton.

Other families

During the course of recording, a variety of other families have been recorded on an ad-hoc basis. These are listed in Appendix 1. Given that they do not attract the same level of interest from the majority of dipterists, our knowledge of their biology and conservation importance is much less precise. A few, however, are noteworthy. Of these, *Myennis octopunctata*, currently listed as *RDB*2 by Falk (1991), is well known from Mitcham Common, having been recorded by Len Parmenter in the 1950s 1990s (Parmenter 1950*b*, 1952) and again by me in the early 1990s (Morris 1991). It has been found in association

with dead timber of both Lombardy poplar *Populus nigra* var. *italica* and white poplar *Populus alba* on Mitcham Common (Morris 1991). Since then, *M. octopunctata* has been discovered on nearby Beddington Sewage Farm on 22.viii.1998 (Collins 1999) and is also reported from Richmond Park (Miles 1993).

The picture-winged fly *Goniglossum wiedemanni*, listed as Nationally Scarce, is another of the more noteworthy. The larvae of *G. wiedemanni* are associated with the berries of white bryony *Bryonia dioica* and were found in numbers at one white bryony plant on the Seven Islands Pond site on three occasions in 1990 (23.v., 6.vi, 10.vi.1990). The big-headed fly *Pipunculus zugmayeriae* is also listed as Nationally Scarce, but very little is known of its biology other than its membership of a family that is largely endoparasitic upon homopteran bugs.

Despite the relative lack of wetland habitats, two Nationally Scarce species with close wetland associations are also recorded. The picture-winged fly *Dioxyna bidentis* breeds in the seed heads of tripartite bur-marigold *Bidens tripartita* and has been recorded by sweeping the few plants that occur on pond edges. *Sciapus contristans*, a member of the spectacular metallic Dolichopodidae, is a truly wetland species, but is otherwise poorly known. These species suggest that there is scope for more interesting discoveries amongst the less well known groups.

Discussion

Mitcham Common largely comprises dry grass heath and recent secondary woodlands (see description in Morris 1997). As shown in Table 6, which evaluates the extent of suitable Diptera habitat on a DAFOR scale, there are few lush wetlands or trees capable of supporting saproxylic assemblages. Furthermore, the pH is acidic. As a consequence, the fly fauna is inevitably deficient in specialist wetland species, those that are associated with calcareous habitats, and of course saproxylic species. This means that many families with specialist habitat associations will be poorly represented: borne out, for example, by the general absence of horseflies, many stem-feeding hoverflies and saproxylic Diptera associated with wet rot holes and decaying timber.

Conversely, the records illustrate the importance of dry grassland habitats for families such as the robberflies and for hoverflies and Conopidae that are closely associated with Hymenoptera (see Tables 3 and 4). The dominance of aphidophagous hoverflies is a further indication of this environment, reflecting the opportunities presented to those species associated with aphids that favour dry open habitats and arboreal aphids.

There are a number of enigmatic records that are difficult to explain. In particular, the record of *Odontomyia ornata* in 1900 raises interesting questions about the state of the site earlier in the twentieth century. At that time, the Common supported extensive wetlands that were lost as gravel workings were infilled. What might have occurred at that time can only be a matter of conjecture, but as has been noted in relation to wetland hoverflies, the impact of infilling and human visitor pressure are such that a variety of species must have been lost. Two dung feeders, *Asilus crabroniformis* (29.viii.1991, D.C. Lees) and *Rhingia campestris* (27.viii.1988, RKAM) that are also represented by single records are noteworthy because they might not be immediately thought of as resident on a suburban grass heath. Do they reflect resident populations or vagrants from elsewhere?

Unlike the Hymenoptera fauna, which is comparatively rich because such species favour warm dry environments, the Diptera fauna largely comprises commoner or more ubiquitous species, and relatively few scarce species. Using the site quality index described in Morris (1997), it is apparent from Table 5

that the variation in species-richness of hoverflies across the sub-sites is much less pronounced than in the Hymenoptera. This table has been prepared using the following scoring system:

Status	**Status score**
Common/Universal (Surrey)	1
Local (Surrey)	2
Regionally Notable = status of scarce/rare in Surrey (Morris 1998)	4
Nationally Scarce	8
Red Data Book	16

Some of the variation in relative species-richness is undoubtedly an artefact of recorder effort, reflecting the lower numbers of common/ubiquitous species recorded on some sites that have been less well assiduously recorded. More detailed recording of sites B, C, D and G is therefore likely to reveal a greater proportion of the common/universal species, which are noticeably under-represented in the samples, and as a consequence the site quality scores are likely to become much more uniform.

A simpler evaluation of the conservation interest of the Diptera fauna can be obtained from the variety of Red Data Book and Nationally Scarce species recorded from the site as depicted in Tables 7 and 8. These tables show that the spread of habitat and species associations of *Red Data Book* and Nationally Scarce species is broad, but there are few indications of any particularly outstanding assemblage either according to families of flies or in relation to particular niche associations.

Unlike those species associated with grassland, wetland or scrub woodland habitat, the saproxylic species *Myennis octopunctata*, *Brachyopa insensilis* and *Solva marginata*, are dependent on introduced plantings of poplars, sycamore and horse chestnut. The occurrence of these otherwise scarce species raises the important question of how widespread they might be in the urban environment where trees such as poplars and horse chestnut are popular plantings? As Coleman and Boyle (2000) have shown, urban poplars can be important for the hornet clearwing moth *Sesia apiformis*, and it is plausible that species such as *M. octopunctata* and *S. marginata* are more widespread than records currently suggest. These records therefore provide an indication of a useful avenue of conservation research into the importance of urban trees to saproxylic invertebrates, including those that are associated with rotting timber and rot holes. They also highlight the need for local authority arboricultural staff to recognize the importance of such timber for saproxylic invertebrates and action needed to safeguard their future survival as part of local biodiversity action plans.

This brief analysis has shown that it is extremely difficult to place well-recorded sites into context because of the very limited dataset in the published literature and the need for data from comparable habitats. From those limited datasets available, the contribution of saproxylic and wetland habitats to the richness of the hoverfly fauna is readily apparent. The various recording schemes do hold good data for a small number of sites, but very few sites are adequately recorded and there are considerable differences in the size of the sites and the intensity of recording. Clearly there is much scope for the assiduous student to make useful contributions to our knowledge of the Diptera fauna of the London area and elsewhere.

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TABLE 1. Representation of families of Diptera on Mitcham Common compared with other published faunas in the London Natural History Society recording area.

Family	Number of spp. (UK)	Mitcham Common	Epping Forest*	Great Bookham Common**	Limpsfield Common**
Xylophagidae	3	0	0	0	1
Rhagionidae	15	3	5	5	4
Tabanidae	30	1	3	9	1
Xylomyiidae	3	1	2	0	0
Stratiomyidae	48	16	13	13	5
Acroceridae	3	2	3	2	0
Bombyliidae	9	1	1	1	0
Therevidae	14	2	0	1	0
Scenopinidae	2	0	1	0	0
Asilidae	29	8	9	8	5
Syrphidae	272	100	123	133	58
Conopidae	24	7	7	8	0
Totals	**451**	**141**	**170**	**180**	**74**

* Hanson (1985) reports 119 species of hoverfly for Epping Forest *sensu stricto* and 126 from the Epping Forest area, but his species list reports on 123 species.

** includes species on database recorded subsequent to published account.

TABLE 2. Hoverflies recorded from the main recording units of Mitcham Common as depicted in Morris (1997).

Species	Surrey status	Site						
		A	B	C	D	E	F	G
Baccha elongata	Common	×					×	
Melanostoma mellinum	Ubiquitous	×			×		×	
M. scalare	Ubiquitous	×			×	×	×	
Platycheirus ambiguus	Local	×		×		×	×	
P. albimanus	Ubiquitous	×		×	×	×	×	
P. angustatus	Local	×	×	×	×			
P. clypeatus (s.s. and agg.)	Common	×		×	×	×	×	
P. granditarsus	Common				×	×		

Species	Surrey status	Site						
		A	B	C	D	E	F	G
Platycheirus peltatus (agg.)	Local	Recorded by L. Parmenter						
P. rosarum	Common							×
P. scutatus	Common	×	×			×	×	
P. splendidus	(Not listed)	11.v.1989, RKAM						
Paragus haemorrhous	Local	×						
Chrysotoxum bicinctum	Common	×	×	×	×	×	×	
C. cautum	Common	×				×	×	
C. festivum	Local	×	×	×		×	×	
C. verralli	Local	×	×					
Dasysyrphus albostriatus	Common	×	×	×	×	×	×	
D. tricinctus	Local			×		×	×	
D. venustus	Common					×	×	
Didea fasciata	Local (NS)	×				×	×	
Epistrophe diaphana	Local (NS)*	A.E. Stubbs — ISR records						
E. eligans	Ubiquitous	×	×	×	×	×	×	
E. grossulariae	Common	×					×	
E. melanostoma	Local	(Beuk 1990)						
E. nitidicollis	Local	×	×			×	×	
Episyrphus balteatus	Ubiquitous	×	×	×	×	×	×	
Eupeodes corollae	Common		×			×	×	
E. latifasciatus	Local	×			×			
E. luniger	Ubiquitous	×	×	×	×	×	×	
Leucozona laternaria	Local	×						
L. lucorum	Ubiquitous	×	×		×		×	
Melangyna cincta	Local					×	×	
M. labiatarum	Common	×			×	×		
M. lasiophthalma	Local	×						
M. umbellatarum	Local	×				×		
Meligramma guttatum	Rare (NS)*	Recorded by L. Parmenter						
M. trianguliferum	Scarce (NS)*					×		
Meliscaeva auricollis	Common	×		×		×		
M. cinctella	Common	×						
Parasyrphus punctulatus	Local	×						
Scaeva pyrastri	Common		×	×	×	×	×	
Sphaerophoria rueppellii	Local			×		×		
S. scripta	Ubiquitous	×	×	×	×	×	×	
S. taeniata	Common						×	
Syrphus ribesii	Ubiquitous	×	×	×	×	×	×	
S. torvus	Common	×				×		
S. vitripennis	Ubiquitous	×	×			×	×	
Xanthogramma citrofasciatum		Scarce			×			×
X. pedissequum	Common	×	×	×		×	×	
Cheilosia albitarsis agg.	Ubiquitous	×			×	×		
C. bergenstammi	Common	×						
C. carbonaria	Rare (NS)*	Recorded by L. Parmenter						
C. grossa	Rare	×						
C. illustrata	Common	×		×	×	×	×	

Species	Surrey status	Site						
		A	B	C	D	E	F	G
C. impressa	Common				×	×		
C. pagana	Ubiquitous	×			×	×	×	
C. proxima	Common					×	×	
C. urbana	Local					×		
C. variabilis	Common							×
C. velutina	Rare (NS)*	×						
C. vernalis	Common	×					×	
C. vulpina	Local					×		
Rhingia campestris	Ubiquitous	×						
Brachyopa insensilis	Local (NS)*	Not from main sites						
Melanogaster hirtella	Common				×			×
Neoascia podagrica	Common					×	×	
N. tenur	Local	×						
Orthonevra nobilis	Local					×		
A. transfuga	Rare	×						
Eristalinus sepulchralis	Common	×	×	×	×	×	×	
Eristalis arbustorum	Ubiquitous	×	×	×	×	×	×	
E. horticola	Common		×					
E. interruptus	Ubiquitous					×		
E. intricarius	Common	×	×	×	×	×	×	
E. pertinax	Ubiquitous	×	×	×	×	×	×	
E. tenax	Ubiquitous	×	×	×	×	×	×	
Helophilus hybridus	Local	×	×			×	×	×
H. pendulus	Ubiquitous	×	×	×	×	×	×	
H. trivittatus	Local	×			×		×	
Myathropa florea	Ubiquitous	×	×	×	×	×	×	
Parhelophilus frutetorum	Local						×	
Eumerus funeralis	Local			×		×		
Merodon equestris	Common	×		×		×	×	
Heringia heringi	Local			×		×		
H. vitripennis	Scarce					×	×	
Pipiza bimaculata	Rare		×					
P. luteitarsis	Scarce		×	×		×		
P. noctiluca	Common	×	×	×	×	×	×	
Pipizella viduata	Common	×		×	×	×	×	
P. virens	Local (NS)*	×				×		
Triglyphus primus	Rare (NS)*					×		
Volucella bombylans	Common	×	×	×	×	×		
V. inanis	Common (NS)*	×	×	×	×	×	×	
V. pelluscens	Ubiquitous	×	×	×	×	×	×	
V. zonaria	Local (NS)*	×	×		×	×	×	×
Chalcosyrphus nemorum	Local	×						
Syritta pipiens	Ubiquitous	×	×	×	×	×	×	
Xylota segnis	Ubiquitous	×	×	×	×	×		
Xylota sylvarum	Common					×		
Totals		**64**	**35**	**37**	**38**	**64**	**52**	**5**

* (NS) = status Nationally Scarce, as given in Falk (1991).

TABLE 3. Comparisons between assemblages of hoverflies at Mitcham Common and well-recorded sites in Greater London and Surrey. Column 1 = actual numbers. Column 2 = % of total fauna.

Site	Number of spp.	Plant feeders		Saproxylic		Aquatic		Wetland		Dung		Predacious		Hymenoptera associates	
Ashtead Common	**93**	17	18.0%	9	10%	10	11%	5	5%	1	1%	41	44.0%	10	11.0%
Box Hill	**104**	18	17.0%	14	13%	9	9%	5	5%	1	1%	48	46.0%	9	9.0%
Chobham Common	**97**	13	13.0%	9	9%	12	13%	9	9%	1	1%	47	48.0%	6	6.0%
Epping Forest	**123**	17	14.0%	17	14%	17	14%	12	10%	1	1%	49	40.0%	10	8.0%
GreatBookham Common	**133**	22	16.5%	15	11%	17	13%	9	7%	2	1.5%	58	43.5%	10	7.50%
Kew Gardens	**80**	9	11.0%	12	15%	9	11%	5	6%	1	1%	36	45.0%	8	10.0%
Mitcham Common	**100**	15	15.0%	5	5%	12	12%	5	5%	1	1%	52	52.0%	10	10.0%
Thursley Common	**89**	8	9.0%	10	11%	14	16%	10	11%	1	1%	34	38.0%	10	11.0%
Wisley RHS Gardens	**116**	17	15.0%	17	15%	15	13%	8	7%	1	1%	48	41.0%	10	8.0%

TABLE 4. Comparative Conopidae faunas from Mitcham Common and other well-recorded sites in Surrey and Greater London.

Species	Chobham Common	Epping Forest	Gt. Bookham Common	Kew Gardens	Mitcham Common
Conops ceriaeformis	×			×	×
C. flavipes	×	×	×	×	
C. quadrifasciata	×	×	×		×
C. strigata			×		
C. vesicularis	×				
Leopoldius signatus		×			×
Myopa buccata	×		×	×	
M. extricata				×	
M. fasciata	×		×		
M. polystigma	×	(x)			
M. testacea		×	×	×	×
Physocephala rufipes		×	×	×	×
Sicus abdominalis	×				×
S. ferrugineus	×	×	×	×	×
Thecophora atra			×		
Totals	**9**	**7**	**9**	**7**	**7**

(x) Since this record was reported, *M. polystigma* has been shown to comprise two species, *M. polystigma* and *M. tessellatipennis*.

TABLE 5: Site quality scores for hoverflies of Mitcham Common, following the approach discussed in Morris (1997).

Status	Status score	Site						
		A	**B**	**C**	**D**	**E**	**F**	**G**
Ubiquitous/ Common (Surrey)	1	42	26	27	32	43	39	3
Local (Surrey)	2	17	5	7	4	15	9	1
Scarce/Rare (Surrey)	4	2	2	2	0	2	2	0
Nationally Scarce (GB)	8	3	2	1	2	4	2	1
Red Data Book	16	0	0	0	0	0	0	0
Total species (TSp)		64	35	37	38	64	52	5
Total score (TSc)		108	60	57	56	97	81	11
Site Quality Index*		**1.69**	**1.71**	**1.54**	**1.47**	**1.52**	**1.56**	**N/A**

* Site Quality Index = total score (TSc) divided by total species (TSp).

TABLE 6. Evaluation of sample sites using habitat features favoured by Diptera.

	Site						
Attribute	**A**	**B**	**C**	**D**	**E**	**F**	**G**
Dead wood (wet)	2	1	1	2	2	2	1
Rot holes and sap runs	2	1	1	1	2	2	1
Woodland/Scrub	4	4	2	3	4	4	2
Open acid grasslands	4	3	3	1	4	3	2
Ruderal grasslands	4	4	3	4	2	5	2
Wetland, marginal vegetation and ditches	2	0	3	2	3	0	4
Wetland, open water	4	0	2	4	2	0	4
Total of DAFOR habitat attributes	**22**	**13**	**14**	**17**	**19**	**16**	**16**

DAFOR Scale 1 to 5 (Dominant = 5, rare = 1)

TABLE 7. Representation of *Red Data Book* and Nationally Scarce species in families of Diptera recorded on Mitcham Common.

Family	***RDB*1**	***RDB*2**	***RDB*3**	**Nationally Scarce**
Acroceridae	–	–	–	(+1)
Asilidae	–	–	–	1
Conopidae	1	–	–	1
Dolichopodidae	–	–	–	1
Otitidae	–	1	–	–
Pipunculidae	–	–	–	1
Stratiomyidae	–	(+1)	–	3
Syrphidae	–	–	–	8(+3)
Tephritidae	–	–	–	2
Xylomyidae	–	–	–	1
Total modern records	**1**	**1**	**0**	**18**
Total old records	**0**	**1**	**0**	**4**
Total records	**1**	**2**	**0**	**22**

Parentheses indicate records 25+ years old.

TABLE 8. Habitat associations of *Red Data Book* and Nationally Scarce flies from Mitcham Common.

Grassland/ herbaceous	Woodland	Plant feeders	Wetland/ aquatic	Saproxylic	Hemiptera parasites	Bee/Wasp associates
*Ogcodes gibbosus**	*Meligramma trianguliferum*	*Cheilosia carbonaria*	*Odontomyia ornata*	*Solva marginata*	*Pipunculus zugmayeriae*	*Volucella inanis*
Asilus crabroniformis	*Meligramma guttatum*	*C. velutina*	*Odontomyia tigrina*	*Brachyopa insensilis*		*V. zonaria*
Epistrophe diaphana	*Didea fasciata*	*Goniglossum wiedemanni*	*Stratiomys potamida*	*Myennis octopunctata*		*Sicus abdominalis*
Pipizella virens		*Dioxyna bidentis*	*S. singularior*			*Leopoldius signatus*
Triglyphus primus			*Sciapus contristans*			

* A spider parasite that is seemingly a dry grassland species (see Morris 2000).

APPENDIX

Records of less-popular Diptera families

Bibionidae: *Bibio hybridus*, *Bibio johannis*, *Bibio lanigerus*, *Bibio lepidus*, *Bibio leucopterus*, *Bibio marci*, *Dilophus febrilis*, *Dilophus femoratus*.

Chloropidae: *Chlorops pumilionis*, *C. speciosus*, *Elachiptera megaspis*, *Oscinella nigerrima*, *Thaumatomyia notata*.

Dolichopodidae: *Dolichopus festivus*, *D. latelimbatus*, *D. plumipes*, *D. trivialis*, *D. ungulatus*, *D. wahlbergi*, *Hercostomus aerosus*, *H. metallicus*, *H. nigripennis*, *Poecilobothrus nobilitatus*, *Scellus notatus*, *Medetera saxatilis*, *M. truncorum*, *Rhaphium antennatum*, *R. caliginosum*, *Syntormon denticulatum*, *S. pallipes*, *Neurigona quadrifasciata*, *Chrysotus gramineus*, *Campsicnemus curvipes*, *C. scambus*, *Sympycnus desoutteri*, *Sciapus contristans*.

Empididae: *Empis aestiva*, *E. bicuspidata*, *E. caudatula*, *E. femorata*, *E. livida*, *E. nuntia*, *E. praevia*, *E. scutellata*, *E. tessellata*, *E. trigramma*, *Hilara interstincta*, *H. litorea*, *Hybos culiciformis*, *Rhamphomyia longipes*, R. *subcinerasceus*, *R sulcata*, *R. tarsata*.

Heleomyzidae: *Suillia affinis*, *S. atricornis*, *S. bicolor*, *S. notata*, *S. variegata*, *Tephrochlaena halterata*.

Hybotidae: *Bicellaria pilosa*, *B. vana*, *Platypalpus agilis*, *P. clarandus*, *P. cursitans*, *P. minutus*, *P. pallidiventris*.

Lauxaniidae: *Calliopum aeneum*, *Lyciella platycephala*, *Minettia longipennis*, *M. lupulina*, *M. rivosa*, *Sapromyza quadripunctata*.

Keroplatidae: *Orfelia nemoralis*.

Lonchopteridae: *Lonchoptera lutea*.

Mycetophilidae: *Brevicornu sericoma*, *Dynatosoma fuscicorne*, *Exechia fusca*, *Mycetophila britannica*, *M. fungorum*, *Phronia coritanica*, *Sceptonia nigra*, *Zygomyia notata*.

Opomyzidae: *Geomyza breviseta*, *G. tripunctata*, *Opomyza florum*, *O. germinationis*.

Otitidae: *Ceroxys urticae*, *Myennis octopunctata*, *Seioptera vibrans*.

Pipunculidae: *Eudorylas fuscipes*, *E. longifrons*, *E. subfascipes*, *E. subterminalis*, *Pipunculus campestris*, *P. thomsoni*, *P. zugmayeriae*, *Tomosvaryella geniculata*, *Verrallia aucta*.

Psilidae : *Chamaepsila bicolor*.

Scathophagidae: *Cordilura albipes*, *Nanna fasciata*, *Norellisoma spinimanum*, *Scathophaga lutaria*, *Scathophaga stercoraria*.

Sciomyzidae: *Dichetophora obliterata*, *Elgiva cucularia*, *Hydromya dorsalis*, *Pherbellia ventralis*, *Sepedon sphegea*, *Tetanocera arrogans*, *T. elata*, *T. ferruginea*.

Sepsidae: *Nemopoda nitidula*.

Tachinidae: *Eriothrix rufomaculata*, *Tachina fera*.

Tephritidae: *Anomoia purmundus*, *Campiglossa misella*, *Chaetorellia jaceae*, *Dioxyna bidentis*, *Euleia heraclei*, *Goniglossum wiedemanni*, *Oxyna parietina*, *Urophora cardui*, *U. jaceana*, *Tephritis bardanae*, *T. cometa*, *T. hyoscyami*, *Xyphosia miliaria*.

Volucella zonaria (Diptera, Syrphidae) in the London Area

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Introduction

Volucella zonaria is the largest British hoverfly and is particularly noteworthy because of its size and its distinctiveness as a chestnut-and-golden hornet mimic. The only species with which it can be confused is *Volucella inanis*, which is smaller and yellower, and has a yellow rather than black second sternite. Both species are depicted particularly well in Colyer and Hammond (1968). It is a relatively recent arrival that appears to have become established in the late 1930s or early 1940s (Morris and Ball, in press). The first year in which *Volucella zonaria* was noted in numbers was 1945, with all records from coastal or near-coastal locations, and it was not until 1946 that records started to emerge from the London Area. Reports are somewhat contradictory, but it would appear to also have first become established in the London Area in 1945 on Wimbledon Common (Morris and Ball, in press).

During the early stages of its establishment in London, records suggest that the epicentre was the Wimbledon/Putney area which yielded a regular stream of records, together with others from the Hounslow/Osterley area, followed by records towards New Malden, Herne Hill and Eltham. From then on, a steady spread of records towards the suburbs continued with regular published records until the 1960s when reporting in the entomological press largely ceased. These reports, together with museum specimens form the basis of our knowledge of the early days of *Volucella zonaria* in England.

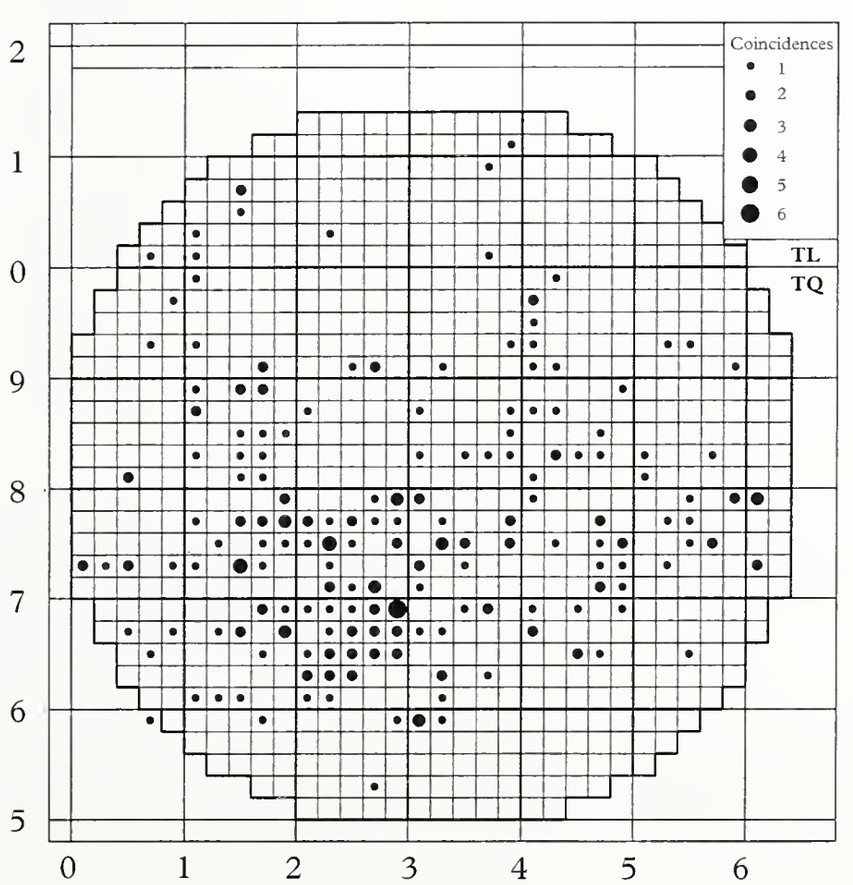

FIGURE 1. Distribution of *Volucella zonaria* in the London Area.

This map depicts scaled spots that reflect the total number of years (1945–2001) when *V. zonaria* has been reported from a particular tetrad (coincidences = numbers of years recorded).

The establishment of the Hoverfly Recording Scheme in the 1970s meant that recording became more consistent where interested observers reported their sightings on a regular basis. However, many casual recorders who either did not know of the scheme, or were only interested in passing, will not have contributed records. Thus today's maps of known current or past occurrence probably do not properly reflect the distribution of this fly in the London Area. Figure 1 shows the current extent of known records from the London Natural History Society recording area that can be ascribed to a tetrad, and demonstrates the highly patchy nature of recording, but also the heavy concentration of records in south-west London.

Current distribution

Data supplied to the Hoverfly Recording Scheme clearly indicate that *Volucella zonaria* is undergoing a period of further expansion after some fifty years of fairly constant distribution centred on the south coast, London and the Thames Estuary. Recent records from Cornwall, the Harwich/Felixstowe area, Sheringham in Norfolk, and from Gloucestershire are indicative of this spread. In a London context, records from rural Surrey, and especially from Watford in Hertfordshire and the Reading/Maidenhead area of Berkshire, suggest an expansion of range from its traditional association with urban areas.

The association of *Volucella zonaria* with the urban environment provides a clue to the reasons for the highly restricted range of this recent arrival. Urban areas the size of London are known to be have elevated temperatures and are less susceptible to frosts. This is the so-called heat-island effect that can lead to urban temperatures elevated as much as 7°C above adjacent rural areas (USEPA 1992). The lower incidence of frosts is something urban areas have in common with coastal areas that are influenced by their proximity to the sea and more constant temperatures above freezing. They also experience somewhat elevated summer temperatures because of radiated heat from buildings, pavements, etc. Thus, it is reasonable to suggest that *V. zonaria* is expanding its range in response to the ongoing period of warmer weather, with consistently warmer winters and fewer sub-zero temperatures. Our studies have demonstrated a remarkably close similarity between the distribution of *V. zonaria* and those parts of England that experience average January temperatures above 1°C and daytime summer temperatures exceeding 20.5°C (Morris and Ball, in press).

It is noteworthy, however, that the majority of regular reports of *Volucella zonaria* are from parts of London that have extensive open, wild land such as the extensive common land at Wimbledon and Putney, and around Hounslow. It is not clear whether this is a genuine concentration of the population or that it reflects the better recorded areas. It is noteworthy that Plant (2001) reports just two records from Buckingham Palace Garden between 1995 and 1997, even though parts of the garden are relatively 'wild'. He speculates that this may reflect low numbers of social wasps, *Vespula*. However, the low frequency of *V. zonaria* and *Vespula* species may also reflect the urban nature of the site. However, it is as yet unclear whether *V. zonaria* is more widely distributed in wholly urban areas, something that more detailed recording would help to answer.

At the moment, it is believed that *Volucella zonaria* is an established British species and that its expansion derives from locally bred individuals. There is, however, anecdotal evidence that the British population may be augmented by influxes from Europe, which may be responsible for some outlying coastal populations.

Future studies and monitoring

One our principal objectives is to follow the expansion of range of *Volucella zonaria* in forthcoming years. However, it is apparent from this short note that

our knowledge of its distribution in its urban stronghold is not entirely robust: records from urban London make up a small proportion of all records received and seem likely to represent under-recording. It would therefore be helpful to establish whether *V. zonaria* is actually more widespread and abundant in urban London than current records suggest.

We also hope to develop a network of recorders who maintain regular notes of this species to examine the numbers occurring each year and the relative proportions of males to females (females seem to outnumber males by a ratio of three to one). Thus, we would welcome all new records together with details of flowers visited and numbers of individuals on particular days. Detailed observations of the occurrence of this hoverfly and notes on the frequency of other known migrants such as *Episyrphus balteatus* and *Scaeva pyrastri*, which often arrive in huge numbers, may help to establish the likelihood of arrivals from Europe further bolstering the population. For example, do high numbers of *Volucella zonaria* coincide with influxes of the known migratory species?

Acknowledgements

This account is based on the records supplied by the many contributors to the Hoverfly Recording Scheme, without whom we could not have undertaken this project and the analyses that are possible with such a considerable dataset. We also thank Colin Plant who offered helpful suggestions for improvements to this text.

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Book review

British hoverflies. An illustrated identification guide. Alan. E. Stubbs, colour plates by Stephen J. Falk. 2nd edition 2002, revised and updated by Stuart G. Ball, Alan E. Stubbs, Ian F.G. McLean, Roger K.A. Morris, Stephen J. Falk and Roger D. Hawkins. British Entomological and Natural History Society. 469pp. ISBN 1-899935-05-3. £30 + £5 p. and p. from BENHS Sales, c/o 91 Fullingdale Road, Northampton NN3 2PZ.

The first edition of this book set a standard for simple keys with marginal illustrations of the key characters seen by entomologists before only in Chinery's *Guide to the insects of Britain and northern Europe*. Other publishers who put traditional presentation and erudition above clarity are now challenged to improve their presentation. The availability of the first edition promoted an upsurge in interest in hoverflies and in the national recording scheme. This resulted in the addition of a number of species to the British list, especially in genera that were being taxonomically revised. Reprints and supplements became cumbersome, so the fruits of the recording scheme, taxonomic and ecological research since 1983 have been incorporated in this revised edition. The preface records the immense task of converting the first edition to electronic format for revision and future updating, followed by incorporation of new material on a time scale of months to raise the new edition from 252 pages to 421 pages plus the original 12 coloured plates and one plate of line drawings.

Text on the individual species concentrates on recognition, especially in the face of variation. Distribution, habitats, adult behaviour, flight period and food of the larvae (when known) are given.

Further details of known distributions can be sought in Ball, S.G. and Morris, R.K.A., 2000, *Provisional atlas of British hoverflies (Diptera, Syrphidae)*, Biological Records Centre, Huntingdon.

RAYMOND UFFEN

Spider records for 2002 for the counties of London and Middlesex

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Abstract

New and interesting spider records for the counties of London and Middlesex in 2002 are detailed. There were sixteen new records for London (including one species new to Britain previously reported) and five new records for Middlesex.

Introduction

In 2002, altogether 218 species were recorded in the two counties of London and Middlesex, of which sixteen were new to London and five were new to Middlesex. One species new to Britain was recorded as was the arrival at several sites in the London area of the spectacular *Argiope bruennichi.*

During the year pitfall trapping has been extended to a number of interesting sites in the London Borough of Hillingdon, Regent's Park and Hampstead Heath, and collecting trips have been made to a number of other sites. The Society's spider foray to Mile End Park in May was particularly successful resulting in the capture of a jumping spider new to Britain (*Macaroeris nidicolens*: Salticidae) already reported in last year's *LN* (Milner 2002). During that and subsequent visits to the Park two other species new to London were captured. Two large batches of records from investigations of roof gardens mostly in the east of London were received from Dr Richard Jones (pers. comm.) and Ms G. Kadas (Kadas 2002). Dr Jones also provided some records from previous years resulting from his surveys of waterways in the Deptford area and these have been included here, as well as some records of *Araneus alsine* received from Dr Ian Menzies, chairman of the Society's Bookham Common Survey, and some records from various sites (including one species new to Middlesex) provided by Colin Plant. A number of records have been received from other members. Several records of *Argiope bruennichi* (new to London) were received from south London from Richmond Park (in Surrey) to Greenwich Nature Park, but not yet from Middlesex, although it may be confidently predicted that it will appear there if not next summer then in the next few years. *A. bruennichi* was found on Hampstead Heath in September (the first London site north of the river) during the writer's second annual intensive study of the large-orb web spiders on the Ladies' Swimming Pond Meadow.

In the list below those marked * are new to London and those marked ** new to Middlesex. All records are by the writer unless indicated. Trapped means pitfall-trapped unless otherwise stated. Nomenclature and the new order in the list of families are according to Merrett and Murphy (2000).

DYSDERIDAE

Segestria florentina. A single large female of this uncommon and spectacular spider was found under the loose bark of a large dead oak tree inside the deer enclosure in Greenwich Park. This is some considerable distance from the next recorded locality at Charterhouse Square in the City (and only the fifth recorded locality in the old county of London). Is this species spreading or is it just under-recorded?

GNAPHOSIDAE

Haplodrassus signifer. Two males of this uncommon spider were trapped on a dry gravelly bank in Area 4 at Harmondsworth Moor in June. This is only the second recorded locality in Middlesex.

*Drassyllus pusillus**. Prior to 2002 the only recorded localities in either London or Middlesex for this species were Bentley Priory (the Society's spider foray in 1995) and at Harmondsworth Moor in 2001. During the last year however it has been trapped in the Goosepen in Regent's Park (the first record for the county of London), and at several sites in the London Borough of Hillingdon: Freezeland Covert, Mabey's Meadow, Moor Park Fields, Springwell Lane Chalkpit, and both Austin's Lane Pastures and the adjacent Ickenham Marsh. According to Harvey et al.(2002), *D. pusillus* is 'not common' nationally, and its preferred habitat is 'open, dryish areas such as sandy heaths and chalk downland'. This coincides with several of the records here in the London area but two (Freezeland Covert and Ickenham Marsh) are from a quite different habitat; damp, marshy grassland.

ANYPHAENIDAE

Anyphaena accentuata. This species is common and widespread throughout woodland in southern England but there have been surprisingly few records from the London area, and only two localities in Middlesex prior to 2002. This year it was recorded from Queen's Wood for the first time, and also from Furzefield Wood in Hillingdon.

THOMISIDAE

*Misumena vatia**. This beautiful crab spider was recorded from Mile End Park in May as its first locality in the county of London as reported by the writer (in Milner 2002). Later in the summer females were swept from bushes in Greenwich Park and the species was also found at Camley Street Natural Park (by A. Thomas) both in September. A male was also swept from a meadow at Moor Park Fields in Hillingdon in June.

*Ozyptila simplex**. This diminutive crab spider was trapped in rough grass just outside the Bush Cricket Pen at Regent's Park in June, and also at Pryors Field on Hampstead Heath in July.

*Ozyptila brevipes***. This attractively marked crab spider was trapped at Ickenham Marsh in Hillingdon in September and October. According to Harvey et al. (2002) it is generally found in marshy areas (although sometimes on limestone grassland).

PHILODROMIDAE

*Philodromus albidus** (Notable B). A single male of this Nationally Scarce species was found by Dr Richard Jones (pers. comm.) on the roof of Tower Hamlets Cemetery Visitors' Centre in September.

*Philodromus praedatus** (Notable B). A single male of this Nationally Scarce spider was swept from the lower branches of oak trees on Hampstead Heath in June.

*Philodromus collinus** (Notable B). A single female of this Nationally Scarce spider was trapped under a group of pine trees on a tumulus at Hampstead Heath in October. According to Harvey et al. (2002) this species is associated with pine trees and although these ones were planted they may have been host to this species for many years; the writer intends to sweep the foliage of these trees in June 2003.

SALTICIDAE

*Macaroeris nidicolens**(New to Britain). As has been reported previously (Milner 2002) this species was discovered in Mile End Park during the Society's spider foray there in May 2002, and further specimens were seen as late as September.

*Bianor aurocinctus**(Notable A). This nationally rare species has a very limited distribution centred on the East Thames Corridor (Harvey et al. 2002). During 2002 a single female was collected on a green roof at Greenwich Reach in June (Kadas, 2002).

*Pseudoeuophrys erratica**. Dr Richard Jones found two females of this tiny jumping spider on a green roof near Forest Hill in south London in May.

LYCOSIDAE

Pardosa agrestis (Notable B). Further occurrences of this Nationally Scarce species were recorded in 2002. A substantial population was found at Springwell Lane Chalkpit at Harefield in Middlesex with over a hundred individuals trapped between April and July. Other specimens (all male) were collected on roofs at Canary Wharf and the Almeida Theatre in June (Kadas 2002), and on roofs in the Canary Wharf area in September (Jones, pers. comm.).

Pardosa hortensis. A small population of this very local species was found at Springwell Lane Chalkpit, with females trapped from June to October and a single male in June.

Alopecosa cuneata. This uncommon spider, previously recorded from only two sites in London (both on Hampstead Heath) and a single site in Middlesex, was trapped at Mabey's Meadow and Austin's Lane Pastures in Middlesex (both in April) and from a new part of Hampstead Heath, Tumulus Field, in June.

*Arctosa leopardus**. This species is rare in the south-east of England with very few records (Harvey et al. 2002), but a single female was collected on the roof of the Calthorpe Centre in the City in June (Kadas 2002).

AGELENIDAE

Agelena labyrinthica. The field sheet web spider has not been seen on Hampstead Heath for many years although it was reported by Savory and Le Gros (1957). In 2002 however, several webs were found in June in the undisturbed central area of the Ladies' Swimming Pool Meadow. This is apparently in direct response to the much-improved management of the Heath, which is allowing such undisturbed areas to flourish.

Tegenaria silvestris. This woodland relative of the common house spider has only been recorded rarely from Middlesex; in 2002 a single male was trapped at the edge of Ickenham Marsh, where it probably inhabits grass tussocks and hedgerows.

THERIDIIDAE

*Steatoda phalerata**. Females of this uncommon species were found by Ms Kadas (2002) at Clere St, and on the roof of the Almeida Theatre in June (Kadas 2002).

*Theridion pinastri**. As previously reported (Milner 2002) a male was swept from pines at Mile End Park in June.

ARANEIDAE

[*Araneus alsine*. Several Surrey records of this species, known as the 'strawberry spider', from Bookham Common and Epsom Common were received from Dr Ian Menzies.]

Larinioides sclopetarius. As reported last year there are very few records for this spider from London but Dr Richard Jones has informed the writer that during his investigations along the River Wandle and around Deptford Creek he found abundant webs adjacent to and over water in that part of London.

Zilla diodia (Notable B). This Nationally Scarce orb-web spider was previously only known in London from a single (possibly imported) individual at Buckingham Palace Garden. In 2002, a male was swept from long grass at Hampstead Heath Extension and a female was swept from tall herbs in Regent's Park, both in July.

*Argiope bruennichi** (Notable A). This spectacular spider appeared for the first time in London in 2002. Records were received from various people and sites included Richmond Park, Sutton and Greenwich, but the first recorded sighting in the county of London was on the Ladies' Swimming Pool Meadow on Hampstead Heath on 14 September. Careful searching resulted in the discovery of three females in webs some distance apart on the meadow; at least one produced a large egg-sac shaped like a Chinese lantern. So far this spider has not apparently occurred in Middlesex.

THERIDIOSOMATIDAE

*Theridiosoma gemmosum*** (Notable B). A single female of this tiny marshland spider was trapped at Carp Ponds and Broads Dock, a small nature reserve near Heathrow Airport, in June.

LINYPHIIDAE

Dicymbium nigrum/D. brevisetosum.* In 2002 for the first time males of *D. nigrum* were found in the county of London. Previously all specimens had been female (the females of the two species are indistinguishable) or *D. brevisetosum.* The first *D. nigrum* male was trapped at Regent's Park in June, although subsequently further specimens were trapped at Primrose Hill in November and on Hampstead Heath in November and December. At several sites including some meadows in Hillingdon, males of both species were found together, although nearly always with greater numbers of *D. brevisetosum.*

*Entelecara congenera***. Two specimens of this small linyphiid were recorded in Middlesex; in June, Colin Plant collected a female in Ten Acre Wood, Hillingdon and in July a female was swept from gorse bushes on Sandy Heath, Hampstead.

Baryphyma pratense. A single female of this uncommon linyphiid was trapped at Ickenham Marsh in June; there are no other records for this species in Middlesex since 1974.

*Silometopus reussi**. A single female of this uncommon linyphiid was collected by G. Kadas (2002) on a roof at Canary Wharf in June (Kadas 2002).

*Erigone aletris**. In the course of the searches on roof gardens, both Richard Jones (pers. comm.) and Ms Kadas (2002) have found this rare species which appears to have arrived in Britain from North America in recent times; the first British record was from East Lothian in 1976. According to Harvey et al. (2002) the only records since then have been from the Edinburgh/Fife area and a single specimen found near Whitton, North Lincolnshire. The discovery of a colony on roofs in east London is therefore something of a surprise; a male and three females have been taken at Canary Wharf, and other females at Crown Wharf and Greenwich Reach, all in late May and early June.

Ostearius melanopygius. Prior to 2002 there were only two records from Middlesex for this widespread synanthropic species (which has been recorded from many parts of the world including the Azores and New Zealand). This year a single female was trapped at French Grove Wood in Hillingdon in April.

*Porrhomma egeria***. This is a scarce, predominantly cavernicolous species, but in April 2002 a single female was trapped next to a stream in French Grove Wood in Hillingdon.

Centromerus incilium (Notable B). This Nationally Scarce spider has only been recorded three times in London and Middlesex prior to 2002, when a further male was trapped at Springwell Lane Chalkpit in Harefield in April.

Floronia bucculenta. This generally uncommon and infrequent linyphiid (Harvey et al. 2002) has only been recorded from a few sites in the London area in recent years, but in 2002 single females were trapped inside the tumulus enclosure on Hampstead Heath in April, and at Mabey's Meadow, Hillingdon in September.

*Lepthyphantes tenebricola***. This is a woodland spider commoner in the north than the south where it is regarded as local (Harvey et al. 2002), and it had not previously been recorded from Middlesex. During 2002 three females were trapped at Furzefield Wood, two in July and one in September.

HYMENOPTERA: ICHNEUMONIDAE

During 2002 four species of ichneumonid parasite were recorded in the London area, one of them possibly for the first time. Larvae of *Acrodactyla degener* (on several *Lepthyphantes* spp.) were seen as riders on their hosts at Greenwich Park, Moor Park Fields and Furzefield Wood, all in October. *A.quadrisculpta* was found on an immature *Tetragnatha* sp., probably *extensa,* at Ickenham Marsh in June; *Polysphincta rufipes* on *Larinioides cornutus* was collected at Freezeland Covert and Kempton Nature Reserve (Colin Plant, pers. comm.) both in September; while the new record, *Dreisbachia picta* on *Clubiona* sp., probably *comta,* was trapped at Queen's Wood in October.

Acknowledgements

I wish to thank Peter Merrett, Peter Harvey and John Murphy for identifying or confirming the identity of most of the species referred to, and Mark Shaw for identifying the parasites. Thanks is also due to the London Borough of Hillingdon, the Corporation of London and the Royal Parks for supporting the spider surveys in areas under their management or interest.

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Book review

The wasps, ants and bees (Hymenoptera: Aculeata) of Watsonian Yorkshire. Michael E. Archer. Yorkshire Naturalists' Union. 2002. 200pp. ISBN 0-9504093-5-9. £5 + £1.50 p. and p. from the author at 17 Elmfield Terrace, York YO31 1EH.

In this survey Michael Archer distils his experience as recorder of aculeate Hymenoptera for Yorkshire in the 1980s and 1990s in maps providing 10-km square distributions with adjacent paragraphs giving the flight period, national and Yorkshire statuses, total number of records, sites, 1-km grid squares and 10-km grid squares, with the same data since 1970 for all solitary species and for social wasps or 1980 for social bees and ants. An introductory paragraph on each genus gives information on general appearance and nesting biology.

Section 1 includes a brief introduction to aculeates and their habits. Section 2 begins with a history of county recording of aculeates and their developing ways of analysing the data. The author's published work on assessing the completeness of a site survey and the validity of comparing observed faunas is described. Analysis of data sources and brief mention of selected sites within the natural areas of the county complete the main text of this thorough and thought-provoking county fauna. It should be consulted by anyone embarking on a similar project.

RAYMOND UFFEN

London butterfly monitoring report for 2002

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Abstract

Butterflies were monitored by the use of transect walks at 28 sites in London during 2002. Data from these transects were used in the calculation of collated indices.

Introduction

Changes in the abundance of butterflies in London in 2002 as compared with previous years are reported in this paper, primarily using data from sites where butterflies were monitored. London is defined for the purposes of this paper as the area encompassed by the London boroughs, though additional records from the wider London Natural History Society (LNHS) recording area are noted.

Methods

Monitoring was undertaken by the transect walk method, a standard method adopted throughout the United Kingdom. Details of the method have not been repeated here as they are described elsewhere (see Pollard and Yates (1993) and Williams (2000) and the references cited there). At each site a walk was undertaken along the same route, each week, between April and September inclusive, within a standard range of weather conditions conducive to butterfly flight. Counts were made of the number of adult butterflies observed to provide a total for each species for the year at each transect. Totals used for this paper include calculated estimates for weeks missed due to poor weather or the unavailability of the recorders. Collated indices were calculated from the data as described by Williams (2000), but see also Crawford (1991) for an introduction to the use of collated indices in wildlife monitoring; and also Pollard and Yates (1993) and Roy and Rothery (2002). Note that collated indices are not absolute counts of the population (nor are the original site counts), but indices of abundance. The indices are relative from year to year, not from species to species.

The index is collated from the data from transects that have been walked for at least two years. Twenty-eight of these transects were walked in London in 2002. Transects and the years for which their data contributed to the index are listed below, the recorders are listed in the Acknowledgements, and the borough in which the transect is located is given in parenthesis: **Hampstead Heath** (Camden) 1978–2002; **Fryent Country Park** (Brent) 1986–2002; **Beane Hill** (Brent) 1988–2002; **Gutteridge Wood** (Hillingdon) 1990–2002; four transects managed by the Corporation of London and located in the London Borough of Croydon: **Coulsdon Common** 1990–2002; **Farthing Downs** and **Happy Valley NW** 1990–2002; **Kenley Common** 1990–2002; **Riddlesdown** 1990–2002; **Clifford Road Allotments/New Barnet Allotments** (Barnet) 1994–1995, 1997–2002; **Mitcham Common 'route A'** (Merton) 1994–2001; **Mitcham Common 'route B'** (Merton) 1995–2002; **Forty Hill** (Enfield) 1996–2002; **Wandsworth Common Woodland** (Wandsworth) 1996–2002;

Wildfowl and Wetlands Trust Wetland Centre at Barn Elms (Richmond upon Thames) 1996–2002; **Railway Fields** (Haringey) 1997–2002; **Cranford Park** (Hounslow) 1997–2002; **Hutchinson's Bank Nature Reserve** (Croydon) 1997–2002; **South Norwood Country Park** (Croydon/Bromley) 1998–2002; **Trent Country Park** (Enfield) 1998–2002; **Tower Hamlets Cemetery Park** (Tower Hamlets) 1999–2002; **Abney Park Cemetery** (Hackney) 1999–2002; **Gunnersbury Triangle** (Hounslow) 1999–2002; **Roxborough Rough** (Harrow) 1999, 2001–2002; **Brent Reservoir** (Barnet/Brent) 2000–2002; **Elthorne Rough** (Ealing) 2000–2002; **Featherbed Lane Verge / The Gallops** (Croydon) 2000–2002; **Hounslow Heath** (Hounslow) 2001–2002; **Cranebank** (Hounslow) 2001–2002; and **Regent's Canal towpath from Mile End Road to Mare Street** (Tower Hamlets/Hackney) 2001–2002.

Eight other transects were walked in 2002 but have not yet contributed to the collated indices: Alexandra Palace, Bridge Avenue, Highgate Cemetery, Minet Country Park, Minet site BWB land, Riddlesdown Quarry, Spring Park, and West Wickham. Records from these transects and from casual records by LNHS observers have been included in the species accounts where appropriate. Records also contribute towards the county and national databases maintained by Butterfly Conservation.

Results

The species accounts below are based on the collated indices. Indices for 1992 to 2002 are presented in Table 1. The order and nomenclature follow Asher et al. 2001. Estimates of the relative changes in the populations of each species from year to year are given by the difference in the indices. For example, a butterfly with an index of 50 in one year and 25 in the following year would have been seen in half the numbers in the second year as compared with the first year. Indices have been rounded to the nearest whole number and have usually been set at 100 in 1990 or the first year of record: for a technical discussion see Crawford (1991). Reliability of the indices increases with the number of transects: one transect was walked in 1978, two in 1986, three in 1988, eight in 1990, and 28 in 2002. Reliability of the indices may be lower for species with low counts, and in the species accounts below, the 'total count' gives an indication of the size of the count including estimated counts for missing weeks from the transects from which the indices were calculated.

Small skipper *Thymelicus sylvestris* and Essex skipper *Thymelicus lineola*

The small and the Essex skippers are generally counted together by transect walkers due to the difficulty of separating these species in flight. At least one of these two species was recorded on all but two transects. The London habitats are sites with rough grassland, particularly acid and chalk grasslands. Though the index declined compared with 2001, much of the reduction was due to lower counts at the three sites that had high counts in 2001 (Cranford Park, Roxborough Rough and Mitcham Common route B), while there were increases at sixteen of the transects. At fourteen transects, attempts were made to identify a sample of the two species separately. Of a combined sample of 420 individuals, 65 per cent were small skippers and 35 per cent were Essex skippers. However, the Essex skipper appeared in larger numbers at some sites. Total count: 1,747.

Large skipper *Ochlodes venata*

The index for the large skipper increased compared with 2001, but remains lower than for the average of years from 1986 to 1995. At London sites the habitats are rough grassland with scrub. Total count: 634.

TABLE 1. Collated indices for butterfly species in London, 1992–2002. Indices have been rounded to the nearest whole number and have usually been set at 100 in 1990 or the first year of record, though indices may be set at 100 in other years where this aids interpretation. A blank indicates no transect records for that species in that year. A zero implies that that species was not observed on transects in that year. A question mark indicates that a species was present in that year, but that data for subsequent years and/or for more transect sites is required before the calculations can be completed. See the text for further information.

	1992	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Small and Essex skippers	266	78	252	118	185	167	93	106	93	112	88
Large skipper	237	211	205	136	66	61	40	59	58	43	75
Dingy skipper	?	?	?	?	?	100	58	51	61	32	44
Grizzled skipper		?	?	?	?	100	25	63	24	14	41
Clouded yellow	0	0	0	0	100	0	111	0	2,239	0	61
Brimstone	179	118	74	124	112	100	89	90	143	108	107
Large white	575	83	116	138	46	136	265	118	132	114	179
Small white	290	73	120	248	113	317	170	100	148	137	173
Green-veined white	233	83	72	145	58	146	191	99	109	71	114
Orange tip	121	87	36	72	37	81	65	50	79	62	72
Green hairstreak	100	100	0	100	50	73	36	18	15	58	39
Purple hairstreak	100	200	141	205	129	319	520	498	482	307	471
White-letter hairstreak	100	50	0	50	150	93	39	18	19	41	23
Small copper	20	10	38	59	58	62	53	25	13	3	2
Small blue			?	?	?	100	225	175	188	338	0
Brown argus	79	18	60	95	77	103	11	12	20	5	5
Common blue	46	24	90	143	61	79	40	71	57	35	36
Chalkhill blue	55	12	91	109	109	288	75	180	90	80	41
Holly blue	7	4	4	88	105	21	69	41	49	57	43
White admiral							100	0	0	0	0
Red admiral	229	93	127	326	225	103	139	130	266	195	209
Painted lady	58	0	8	12	824	14	9	12	82	9	78
Small tortoiseshell	1,091	474	180	300	116	292	178	142	65	30	16
Peacock	986	1,124	482	567	786	778	1,105	1,103	1,505	1,083	643
Comma	379	107	106	144	107	120	125	116	209	158	139
Dark green fritillary						100	148	181	63	7	11
Silver-washed fritillary								100	300	100	0
Speckled wood	161	171	228	153	75	125	147	167	180	158	219
Wall brown	3	3	2	1	0	0	0	0	0	0	0
Marbled white					100	145	89	78	64	24	30
Gatekeeper	132	80	87	129	156	160	126	183	219	209	197
Meadow brown	125	54	90	105	137	114	161	148	148	94	68
Ringlet	304	180	310	194	64	222	294	351	505	255	309
Small heath	42	10	5	6	21	29	22	9	5	2	2

DINGY SKIPPER *Erynnis tages*
Populations of the dingy skipper were present at some of the chalk grassland sties in south London. The index increased compared with 2001. Total count: 37.

GRIZZLED SKIPPER *Pyrgus malvae*
The grizzled skipper has a distribution restricted to chalk downland sites on the southern edge of London where it is present in small numbers. Total count: 12.

CLOUDED YELLOW *Colias croceus*
Singletons were recorded from three of the index transects and from one of the new transects, and followed the absence of records in London in 2001 but a large migration in 2000. Away from the transects clouded yellows were noted from 27 July to 8 September with records from the Lea Valley Park area at Bully Point, Essex Filter Beds, Walthamstow South Marsh, Walthamstow Reservoirs, Charlton, and Woolwich Common. Total count: 3.

BRIMSTONE *Gonepteryx rhamni*
Though the index was similar to that of 2001 and the brimstone retains an association with downland sites on the southern edge of London, there was further evidence of an increase in range in urban London. At the London Wetland Centre at Barn Elms the count had increased from 1 in 1996 to 78 in 2002. In 2002, the brimstone was widely observed in March, before the transect season commenced, with records from residential gardens and from parks at Cannon Hill, Kensington Gardens, Barn Hill / Fryent Country Park (Wembley / Kingsbury), Bromley, Wimbledon Common, Essex Filter Beds and Lea Valley Park, Whitewebb Wood (TQ 320990), Wood Green at Haringey, on the Watford Road opposite Northwick Park Hospital in Harrow, at Alperton, and along urban roads as at St John's Road in Wembley. Occasional garden and park records continued in April, May, June and August. Total count: 478.

LARGE WHITE *Pieris brassicae*
The large white was recorded on all transects and high counts were made at green spaces in urban London, for example Tower Hamlets Cemetery Park. The index was higher than in 2001. Total count: 1,330.

SMALL WHITE *Pieris rapae*
The small white was widespread and the species was frequent at green spaces in urban London, for example at South Norwood Country Park. The index increased compared with 2001. Total count: 1,862.

GREEN-VEINED WHITE *Pieris napi*
The index for this widespread butterfly was higher than in 2001. Total count: 2,270.

ORANGE TIP *Anthocharis cardamines*
Widely distributed in London, particularly at sites with damp grassland. Total count: 452.

GREEN HAIRSTREAK *Callophrys rubi*
The green hairstreak was recorded from three of the index transects and from one new transect on the chalk downland on the southern edge of London in 2002. Total count: 8.

PURPLE HAIRSTREAK *Neozephyrus quercus*
Recorded from half of the transects, the purple hairstreak generally flies in the evening and therefore was probably more frequent than suggested by the transect count. The index increased as compared with 2001. Total count: 61.

WHITE-LETTER HAIRSTREAK *Satyrium w-album*

Recorded from two transects in 2002, Trent Country Park and the Brent Reservoir, though the counts were too low for a reliable index. Populations located other than on the transects in 2002 were at Trent Park north of Oakwood Station in late June and throughout July, Covert Way, and at Cannon Hill. Total count: 4.

SMALL COPPER *Lycaena phlaeas*

The decline of the small copper continued both numerically and in the number of transect sites at which it was found. Small coppers were recorded on eight out of 28 transects in 2002, whereas as recently as the early mid 1990s, it would have been expected to be present on most transects. It was recorded annually on the garden transect at Forty Hill until 1999. Of the transect sites in London, the small copper now tends to be confined to sites with either acid grassland such as Trent Country Park and Mitcham Common, or chalk grassland. Non-transect records include a relatively large population at Richmond Park. Small coppers were recorded from the Sports Ground and / or New Fields at Trent Park in all of the months from May to October and there were also records from Covert Way and Parkside Farm. Other observations included that from a residential garden in Bromley, at the Brent Reservoir, from Walthamstow Reservoirs in July to September, Alexandra Palace, Minet Country Park and one at St James's Park, SW1 in August. The decline of the small copper in Hertfordshire has been noted by Murray and Wood (2002). Total count: 27.

SMALL BLUE *Cupido minimus*

There were no transect records in 2002 of the small blue from the chalk downland transect on the southern edge where it was recorded during recent years, but it was seen elsewhere at the site in low numbers and on a new transect on chalk in south London. Total count: 0.

BROWN ARGUS *Aricia agestis*

The index remained low following a decline in 1998 (Figure 1). In London the brown argus is now largely confined to chalk downland on the southern edge of the area. Total count: 6.

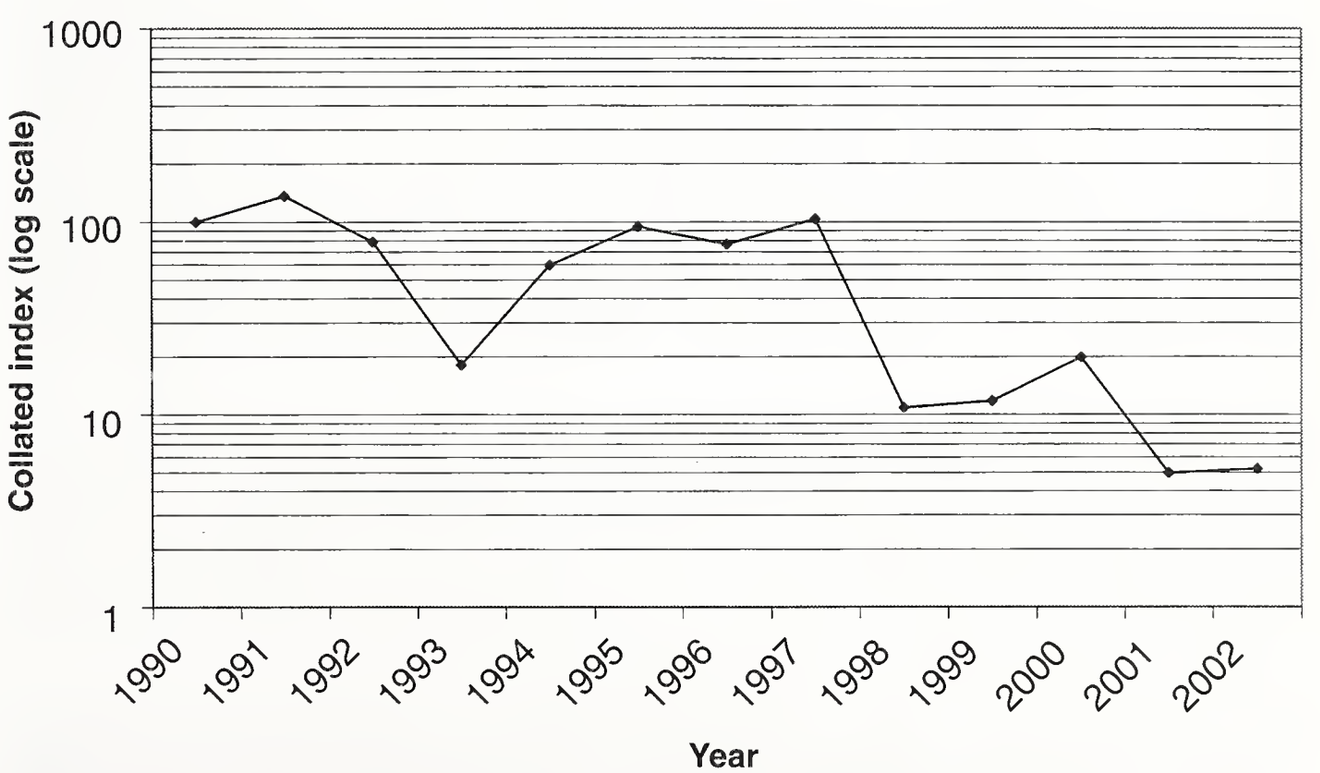

FIGURE 1. **Brown argus**: collated indices for London for the years 1990–2002.

COMMON BLUE *Polyommatus icarus*

Though recorded on most transects, the highest counts were from sites with chalk grassland on the southern edge of London. Relatively high counts were also made at the London Wetland Centre at Barn Elms and at Tower Hamlets Cemetery Park. Total count: 443.

CHALKHILL BLUE *Polyommatus coridon*

A species of chalk downland and recorded on one index transect and one first year transect on the southern edge of London. The index declined. Total count: 28.

HOLLY BLUE *Celastrina argiolus*

More widespread in London than the common blue, the holly blue's larval foodplants include holly and ivy. The holly blue is found in gardens, parks and at the edges of woodland; and in London the largest counts are from green spaces in the urban areas. Total count: 418.

RED ADMIRAL *Vanessa atalanta*

A strong-flying migratory species, the red admiral was recorded on all of the transects in 2002. Recent mild winters or warm days in winter have given rise to 'late' and 'early' records that are respectively before and after the calendar year end, though the butterfly metabolism is probably responding to the air temperature. The red admiral was recorded in London in each month of the year during 2002. Total count: 240.

PAINTED LADY *Vanessa cardui*

The painted lady is a migratory species with large year-to-year fluctuations in numbers. There was a moderate migration in 2002 with small numbers on most of the transects and the index was higher than in 2001. Away from the transects the last record was on 19 October at Enfield. Total count: 69.

SMALL TORTOISESHELL *Aglais urticae*

In 2002 there was a continuation of the decline that has been evident since a peak in 1997, and the index was about a half of that of 2001. Though a widespread species by habitat preference, the small tortoiseshell was not recorded on about a quarter of the transects. Away from the transects there were records of caterpillars on nettles at Cornmill Meadows at Waltham Abbey in July; and records of adults from March through to July at Trent Park despite the zero count on the nearby transect. Analysis of the national butterfly monitoring data has shown that the decline of the small tortoiseshell since 1997 has been a general phenomenon throughout England (Greatorex-Davies and Roy 2001). The detail however contrasts with London, as nationally the lowest index was in 1999 with slight increases in 2000 and 2001, whereas in London the index declined in those years. The national data indicate that numbers are affected by an overriding environmental factor, probably an unidentified weather factor, but other factors such as the influence of parasites cannot be discounted. Total count: 114.

PEACOCK *Inachis io*

Widespread and recorded from all but one of the transects, the index was lower than in 2001 and less than half that of 2000. Total count: 782.

COMMA *Polygonia c-album*

The comma is widespread in London and was recorded on all but one of the transects. Total count: 484.

DARK GREEN FRITILLARY *Argynnis aglaja*

Recorded from one transect site on the southern edge of London, the index remains low compared with the years from the commencement of that transect in 1997 until 2000. Total count: 3.

SPECKLED WOOD *Pararge aegeria*

The index for this widespread species was the highest since 1994. High counts were from woodland transects such as Wandsworth Common Woodland and Tower Hamlets Cemetery Park. At Beane Hill, a site where woodland has been growing since a planting scheme of the mid 1980s, counts have increased from an average of 25 in 1988–1991 to 222 in 1999–2002. Total count: 4,264.

MARBLED WHITE *Melanargia galathea*

Though primarily a butterfly of the chalk downland in London, for example at Hutchinson's Bank Nature Reserve and Featherbed Lane Roadside Verge, the recently established colony at the Brent Reservoir continued to increase. Individuals were also recorded at two acid grassland sites, Mitcham Common and Hounslow Heath, and two were recorded at Gutteridge Wood, and away from the transects, at Tottenham Marshes. Total count: 181.

GATEKEEPER *Pyronia tithonus*

Recorded throughout London and on all but two, urban transects. A large count was recorded at Hounslow Heath, and also from sites with significant areas of semi-natural grassland with scrub or hedgerows. Though there were variations in trend from site to site, the index was similar to that of 2001. Total count: 2,683.

MEADOW BROWN *Maniola jurtina*

The meadow brown is a widespread species of semi-natural grasslands, recorded from all but one urban transect. The index was lower than in 2001 and approximately half that of 2000. There were however large variations in trend between transects. Total count: 5,452.

RINGLET *Aphantopus hyperantus*

In London the ringlet is primarily a butterfly of the chalk downland at the southern edge of London, but small numbers were recorded from South Norwood Country Park, Mitcham Common and Trent Park. The index increased compared with 2001. Casual observations suggest that the ringlet has been spreading into the central area of the Lea Valley Park during 2001 and 2002. Total count: 1,069.

SMALL HEATH *Coenonympha pamphilus*

The index declined slightly from the previous low of 2001 and in 2002 was less than two per cent of the 1990 index value. In London the small heath is now confined to a few sites, whereas the species was much more widely distributed during the 1980s as indicated by the map in Plant (1987). The decline of the small heath in Hertfordshire has been noted by Murray and Wood (2002). Currently the species appears better represented in London on acid rather than chalk grassland. The highest transect count was at Trent Country Park. Away from the transects there were records from New Fields at Trent Park in May through to late September, one at Wimbledon Common and at Hampton Court/Bushy Park. Total count: 69.

For details of species that were recorded beyond London but within the wider LNHS recording area, reference should be made to the respective county reports produced by Butterfly Conservation. In 2002 these records include the white admiral *Limenitis camilla*, observed just beyond the Greater London area at Black Park, Buckinghamshire.

Discussion

Butterfly monitoring uses a standard method to enable the comparison of trends from sites of different areas, habitats or management. The monitoring data used for the London indices reported in this paper can also be used to

analyse changes at individual sites, between sites, and contribute to national databases. Several of the London transects are on sites where agri-environment schemes are applied, in which financial incentives are made available by government to encourage biodiversity in land management. For example there is a Countryside Stewardship scheme in operation at Fryent Country Park and Beane Hill. Using data from 198 butterfly transects in the UK that are within agri-environment schemes in comparison with data from 337 other transects, Brereton, Stewart and Warren (2002) found that there is evidence to indicate that agri-environment schemes are leading to the better management of sites for butterflies. They also conclude that butterfly transects provide a valuable and highly cost-effective method of monitoring the ecological impact of such schemes.

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Survey of Bookham Common

SIXTY-FIRST YEAR

Progress Report for 2002

General (Ian Menzies, Chairman, Bookham Common Survey)

In spite of the generally unsettled weather the Bookham Common Survey has been fortunate that most of the Saturday field meetings and Study Days during 2002 have been accompanied by pleasant sunny weather. Unusually heavy rainfall combined with increased average temperature have had a conspicuous impact, the flooding during the winter and abundant growth of vegetation during summer both presenting problems for National Trust management. A hurdlemaker, G. McCourt, working in the Leith Hill area, has had to adopt a 5–6-year in place of the previous 7–8-year cycle for coppicing hazel 'because the wood is growing so fast' (*The Daily Telegraph,* 26.xi.2002). The possible impact of the heavy rainfall on insect life has been variable – grasshoppers and bushcrickets seem to have increased in numbers but, though the silver-washed fritillary butterfly has done very well there has been a marked decrease in the white admiral and small tortoiseshell. In his bird report Alan Prowse gives some details of the high rainfall. Marshy areas have extended, especially around Common Stream on Central and Bayfield Plains and although sightings of snipe may have something to do with this, ornithological highlights have also included the buzzard and golden oriel.

Field meetings have continued to be well supported, between eight and fifteen members usually attending. The botanists have completed a reappraisal of vegetation on the Common and their report 'Fifty years of botany at Bookham' (Radcliffe and Page), a sequel to 'The flora of Bookham Common' (A.W. Jones, 1954, *LN* **33**: 25–47) and 'Vascular Plants of Bookham Common: a new survey' (Radcliffe and Page, 1981 *LN* **60**: 68–84), appears in the present volume. A further botanical contribution, '*Rubus* on Bookham Common' (K. Page), also appears in this volume.

The study of Bookham Coleoptera has made considerable progress. As a result of recently intensified field studies and further research of Dr. Alan Easton's collection at the Natural History Museum by Maxwell Barclay, the total number of beetle species recorded for the Common has now passed the 1,500 mark, a considerable achievement! An annotated list is now at an advanced stage of preparation.

Management tasks on the Bookham Commons (Ian Swinney, Warden, The National Trust)

The main focus of management activity during 2002 has been on the ponds and wetlands. Management of marshy areas is a specialized problem but, undertaken successfully, can make a great contribution to diversity.

A popular area for visitors, and something of a reference point for the whole common, is the Isle of Wight Pond. It is no surprise that this pond sustains most

of the 'wear and tear' generated by visitors, especially those with dogs which adversely affect vegetation and wildlife at lake margins. At the inlet on the east side an interesting marshy area has been made accessible to visitors by means of a raised plank-walk which allows marsh vegetation and associated fauna such as the brilliant green water-mint beetle *Chrysolina menthastri* to be examined at close quarters without spoiling environment or footware. During 2002 much of the sallow-carr undergrowth around the Eastern inlet has been removed, and an adjustable sluice constructed for the outlet so that water levels can in future be controlled to maintain optimal marshy conditions over an extended open area around the pond.

Trees to the south of Isle of Wight Pond have been thinned to let more light reach the ground vegetation. With a view to the future, younger broad-crowned oaks have been left at strategic points as these will eventually replace the fine old trees of the present canopy. This margin of the pond may look rather bleak at present, but should soon be mellowed by rapid regrowth of vegetation.

Cattle reintroduced during the summer have continued to graze Central, Bayfield and Isle of Wight Plains. Reluctant to reinvest after foot and mouth disease, our grazier was only able to provide six beasts, probably insufficient to make a significant impact at this relatively early stage. The expectation is that cattle would mainly graze the competitively successful plant species and give the smaller, delicate, and usually more interesting plants a better chance, while slowing down, but not halting, regeneration of scrub. Grazing also affects the composition of the remaining scrub, leading to a reduction of the all-pervasive birch and sallow and leaving hardier, slower-growing thorns to contribute protective sites of importance to nesting birds. Grazing should help to maintain plant, and therefore invertebrate, diversity, a cycle which is also to the of advantage of birds and other vetebrates.

Much of our other work, aimed at amenity value, has involved mowing car park surrounds and the manorial waste strips that lead into Great and Little Bookham Commons, with a view to improving presentation to visitors. Although such 'tidying up' may not be entirely pleasing to the conservationist, it improves appearance and, by demonstrating that the area is well cared for, might help to discourage litter and fly-tipping which remain a great nuisance. It is important that land in National Trust care should not look neglected as the impression given to local people and visitors generates more interest and support for our longer-term conservation projects.

The National Trust management must keep a broad view of those features appreciated by visitors, especially with a view to promoting the unusually wide range of wild life supported by the area. In undertaking this during the past sixty years we have depended very much on the specialized studies of the London Natural History Society's Survey to inform, assist and interest us, and The National Trust hopes this collaboration will continue well into the future.

Vegetation — sedges (Ken Page)

The rapid spread of pendulous sedge on the Common in recent years has brought into focus the importance of this group of plants to the flora. During the past half century fifteen species have been recorded here.

Carex pendula pendulous sedge is an imposing and architectural plant that on heavy soils can grow to more than a metre tall. In addition, the graceful pendulous inflorescences are a further attraction. The plant has short rhizomes that restrict the spread of individual specimens, but this restriction is offset by the prodigious amount of viable seed produced. In 1953 one plant was recorded in division R. Today there are many plants in seventeen divisions.

Carex hirta hairy sedge differs from the previous species, having extensive creeping rhizomes and a hairy covering to most parts. Sometimes the hairiness is absent from the leaves and sheaths in shaded and very wet situations but the

utricles (fruits) are always hairy. It is most frequently seen in open grassy areas. Its status (seen in sixteen divisions) has not significantly changed during three surveys in the last fifty years.

Another species preferring open areas is *Carex ovalis* oval sedge. Observed in sixteen divisions but lost in two, it is a somewhat inconspicuous densely tufted sedge, and gets its common name from its oval-shaped fruits.

Most often seen on sandier soils, the pill sedge *Carex pilulifer* is quite rare here (seen in five divisions). It is densely tufted with wiry stems, and leaves that tend to bend earthwards. It is one of the first to flower and fruit, often from April onwards. The small globular fruits are clustered at the top of the stems below a solitary male spike.

Carex flacca glaucous sedge is described as ubiquitous in the British Isles. It is common on nearby chalk grassland but on our London Clay has decreased somewhat. Since the 1954 'Flora' of A.W. Jones it has been lost from three divisions, though still present in eleven. For identification purposes it should be remembered that the leaves are glaucous only on the undersides, and the flowers have three stigmas.

Two similar-looking species are *Carex panicea* and *C. nigra* which have leaves glaucous on both sides. *C. panicea* is known as carnation sedge and has each leaf tip distinctly trigonous (three-sided) and like glaucous sedge its flowers have three stigmas. It has been lost from division T but remains extant in five others. *C. nigra* common sedge belongs to a section with two stigmas and dark glumes. The colour contrast between the dark female glumes and the green utricles at fruiting time is striking. This species has been lost in four divisions but survives in five.

False fox sedge *Carex otrubae* is a species of heavy soils, and on the Common it is often found in the vicinity of ditches where the soil is particularly damp. It has upright, sharply three-angled bright green stems, giving it a distinctive appearance. Over the past fifty years its status (in twelve divisions) has remained more or less unchanged.

Carex spicata spiked sedge was reported under one of its synonyms (*C. contigua*) solely in division P in 1954. It has been observed in three other divisions in recent years. Plants are often tinged wine-red, particularly at their bases, and the bronze-green fruits are in compact clusters near the apex of the stems.

Carex divulsa ssp. *divulsa* grey sedge is part of the group to which spiked sedge belongs. It is a relative newcomer here, not found until the 1977–1979 survey, and seen in a total of three divisions. Its greyish-green appearance and the distant lower spikelets help to separate it from near relatives.

Known for many years as *Carex demissa* and latterly *C. viridula* ssp. *oedocarpa*, common yellow sedge tends to come and go on the Common. As it is small in stature it is probably unable to compete with stronger growing plants — so habitat may be important. We have found it on the edge of one of the ponds, and in bare furrows created by machines elsewhere. It has been lost in two divisions but is still seen in five.

Woodland is the main habitat of the remaining species. The best known and most common is *C. sylvatica* wood sedge, recorded in all twenty divisions. Heavy wet soils suit this sedge, and in the woodland habitat the only likely source of confusion is with thin-spiked wood sedge.

Carex strigosa thin-spiked wood sedge is the rarest sedge on the Common. Since it was first found in 1962 in division A it has been planted deliberately in five other divisions, but of these it has survived only in N. The introductions were carried out when we anticipated loss of this rarity as a result of excavation for a gas pipeline across the Common. Fortunately, the excavation just missed the colony which remains intact in division A. Where these two similar species grow together (as here) it is convenient to look at the differences between the flower spikes: with wood sedge they are distinctly pendulous; with thin-spiked sedge almost upright.

Also growing abundantly in the survey area is *Carex remota* remote sedge which is very tolerant of the shaded and waterlogged habitat. With its very

narrow leaves and spaced-out flower spikes identification is not likely to be a problem. Originally only in eight it is now in all twenty divisions.

We have to report one lost species. *Carex caryophyllea* spring sedge had one site in the 1954 'Flora' but has not been seen since.

Birds (Alan D. Prowse)

The year was a very wet one. Rainfall at nearby Wisley was 873 mm (long-term average 674 mm), and in November and December was twice the long-term average for those months. For SE England the Meteorological Office reported rainfall 32 per cent above average. At least this helped the development of the new small marsh on Bayfield Plain where Bookham Stream has altered its course (see Figure 1).

FIGURE 1. Bayfield Plain, Bookham Common, 20 March 2003. The new 'Snipe Marsh' looking towards Bookham Station. This shot against the light emphasizes the wetness even after a fortnight of drought. *Photo: A.D. Prowse*

Highlight of the year was undoubtedly a golden oriole on 24 May (LG) when one was also at Frensham. Cormorants, formerly rare, are now seen more frequently flying high over the Common. Woodcock were recorded on 13 February (ADP) and 16 April (CP); a snipe on 14 December was the first for some years; sparrowhawks are regular in the non-breeding months with three seen on 8 November. Kingfisher records are not common, but on 4 March one flew across Western Plain, and one was regularly seen on IoW Pond in November and December. Wintering warblers are hardly ever recorded on the common, so a chiffchaff on 8 November is noteworthy. Lesser redpolls were recorded on 18 April and 25 November, the latter with twenty siskins. Bullfinches are present in good numbers in winter, often in pairs, but also in threes (which may have two males or two females). The only hawfinch of the year was on Central Plain on 25 November (ADP). The plentiful crop of berries in the autumn provided food for the good flocks of redwings, and smaller numbers of fieldfares, into the new year.

Breeding season studies. Herons had twenty-two successful nests (RS). Turtle doves have hardly a toehold now; the only records, both on 27 May, were of one singing on IoW Plain and one seen on Western Plain (ADP). Marsh tits had seven known territories but no comprehensive survey of the woodland was done. Little grebes nested successfully one young being seen with an adult on

Eastern Hollow Pond on 7 August when another adult was on Western Hollow Pond. Stock doves were heard singing in several areas and twenty watched feeding on a field near Hundred Pound Bridge on 27 April, most flying in from the Common. At least one pair of tawny owls was successful, with fledged young being seen in May.

Lesser spotted woodpeckers were known in two areas. A nest with young was found on 22 May (A & AS). This nest was predated in the following week. The nest, in a rotten silver birch trunk supported by ivy, was torn open with wood fragments scattered for several feet from the tree. In the absence of more exotic mammals one can only think of grey squirrel as the predator.

On the thirty-nine hectares of plains, surveys included some common species this year, with the following as minimum numbers of territories:

Blackbird 32; song thrush 15; wren 60; dunnock 37; robin 79; great tit 30; long-tailed tit 6; bullfinch 13; chaffinch 30; goldfinch 2; greenfinch 3; magpie 6; cuckoo 2 males, though no records of females calling; reed bunting 1.

Green woodpeckers had seven territories involving the plains, though no territory seemed exclusive to the plains. The distribution of the territory boundaries is shown in Figure 2.

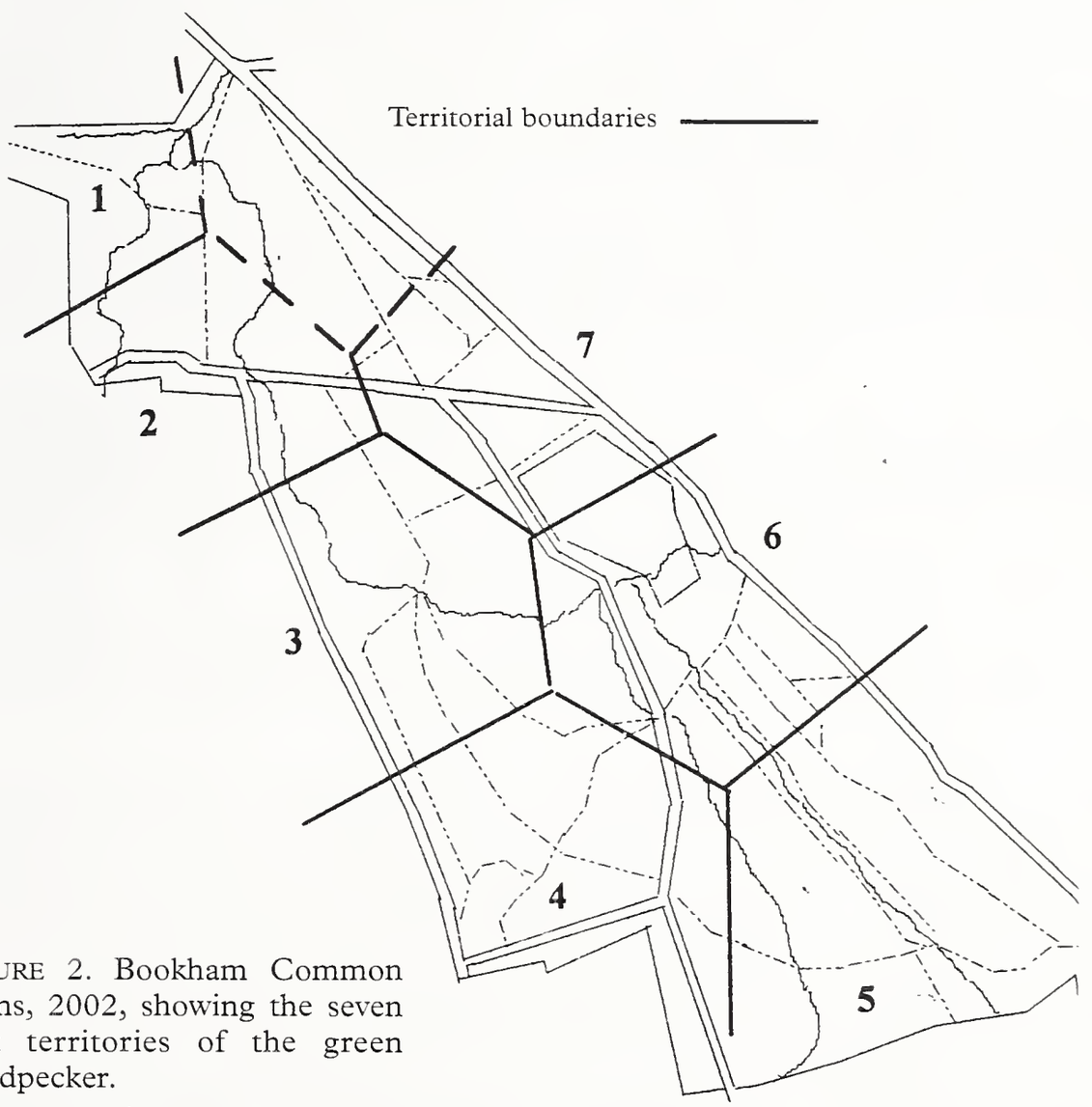

FIGURE 2. Bookham Common Plains, 2002, showing the seven part territories of the green woodpecker.

Warblers. The ongoing warbler survey on the plains gave the following territory totals with 2001 counts in parentheses: chiffchaff 28 (19); willow warbler 5 (14); blackcap 28 (28); garden warbler 22 (29); whitethroat 36 (35); lesser whitethroat migrant only (4 territories). The willow warbler decrease since the thirty-six territories in 1997 continues apace, but its close relative the chiffchaff has increased markedly.

Nightingales. Twelve territories were recorded, though migrants swelled the number of singing sites to eighteen, both being new records for the Common. On Central Plain territories doubled to four. Two of these lasted for some weeks but the birds were then no longer in evidence, perhaps from nest predation. In Prowse (2002) I commented that, at Witley Common, habitats were often used by garden warblers before nightingales. It is, therefore, of interest that this area of the plains held an unprecedented seven pairs of garden warblers in 2001.

Birds of prey. The reported increase in common buzzards in SE England continues. One was seen over the southern plains on 19 February, and one at Hundred Pound Bridge on 28 February (both BMcC); at the latter site a pale phase bird was soaring on 27 April (ADP). A & GP saw two common buzzards soaring just north of Bookham Common and south of the M25 on 30 May. These records were, perhaps, a forecast of things to come. Both male and female kestrels were in evidence through the season though proof of breeding stays elusive.

Sparrowhawks prosper in the area. Unfledged young were heard calling on 24 June (LG) and the young, a male and a female, were still flying with their parents in the nest area on 7 August. Another pair frequented the northern area and both pairs were watched soaring over their respective areas. In addition, female birds from west of the Common came to the western and southern Plains. The usual response of the resident females was to circle slowly towards the trespasser, maintaining a slight height advantage. In all cases the invading bird circled slowly away. In the spring this species could also be seen circling over other woods in the area so there is a good population hereabouts. A local resident to the south east of the Common reports the species regularly hunting at his bird table, taking about three birds a day with a success rate of about one in three or four attacks, and also taking collared doves regularly in the lane outside.

Breeding birds of the London Area. In 2002 the LNHS published *The breeding birds of the London Area* (ed. J. Hewlett). This is a valuable collection of hard-won information. Tetrad maps of species come from field work 1988–94, with some species accounts updated to 2000, though my summary of status in the appendix of Prowse (1998) has been overlooked.

To enable comparison with Montier (1977), and to avoid future confusion, Table 1 shows the present status at Bookam Common, where it varies from Hewlett (2002). The Common overlaps three tetrads (D, H and I) in its relevant 10-km square and, for example, the nightingale breeds in all three.

Changes over five years. The status of various species on the plains was documented for 1997 in Prowse 1998. In the five years since there have been changes. Table 2 summarizes those changes for selected species, including several not included in the earlier paper. Records are for pairs or territories as appropriate for the species, e.g. cardueline finches do not hold breeding territories though the fringilliform finches do. Turtle doves have virtually disappeared, willow warblers have crashed, and cuckoos are less in evidence, all in line with national trends. The fragmentation of the scrub has increased both open spaces and the amount of edge, with benefit to many species including the other species of warblers, nightingales and song thrushes. Greenfinches now breed on the Common. For ease of comparison with other sites densities are also given. The final column gives some densities from the ornithological literature for comparison, largely derived from Cramp et al (1977–94), but also from other sources such as Birkhead (1991). Since many of these figures are from times before modern declines, the column gives some indication of the success at Bookham in preserving our bird population. A paper on the status at Bookham of bird species of conservation concern is in preparation.

Acknowledgements

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TABLE 1. Bookham Common. Present status of species where this varies from Hewlett (2002). Chasemore Farm is adjacent to Hundred Pound Bridge, and the allottments are immediately to the west of Bayfield Plain.

Species	Tetrads	Atlas	Present status	Comment
Little grebe	I	Absent	Breeds	Breeding behaviour yearly, one or two pairs though young not seen in many years
Kestrel	D, H, I	Absent	Birds present, display and are seen throughout season	
Moorhen	H	Present	Breeds	
Tawny owl	H	Absent	Breeds	
Green woodpecker	D	Absent	Breeds	Is common in the area
Nightingale	D	Absent	Breeds	
Lesser whitethroat	H	Present	Bred 2001	Usually passage only
Garden warbler	D	Present	Breeds	Common
Blackcap	D	Present	Breeds	Common
Coal tit	H	Absent	Breeds	Prowse (1998)
Carrion crow	D	Present	Breeds	
Greenfinch	I	Present	Breeds	Several pairs annually in recent years
Linnet	D H	Present Present	Breeds Breeds	(Chasemore Farm) (Allotments) and usually a pair on Bayfield Plain
Bullfinch	D	Present	Breeds	Common
Reed bunting	H I	Absent Absent	Breeds Sometimes breeds	Usually one pair

TABLE 2. Bookham Common Plains (39 hectares).
Pairs/territories for selected species for 1997 and 2002 including densities/sq. km.
For BWP et al* see text.

Species	1997 Prs/territories	2002 Prs/territories	1997 Density prs/sq km	2002 Density prs/sq km	BWP et al* Density prs/sq km
Turtle dove	14	?1	36	0	
Cuckoo (males)	4	2	10	5	m<5/ha
Green woodpecker	3	7 partial	8		to 12
Wren	nc	60		154	to 380
Dunnock	22	37	56	95	to 280
Robin	31	79	80	203	to 300
Nightingale	8	12	20	31	to 30
Blackbird	28	32	72	82	to 300
Song thrush	10	15	26	38	43
Whitethroat	28	36	72	92	to 100
Garden warbler	14	22	36	56	to 60
Blackcap	12	28	31	72	80 (wood)
Chiffchaff	7	28	18	72	to 200
Willow warbler	36	5	92	13	to 200
Longtailed tit	5	6	12	15	to 34
Great tit		30		77	to 150
Chaffinch	17	30	43	77	usually <150
Bullfinch	12	13	31	33	to 21
Goldfinch	2	2	5	5	in UK 5 to 10
Greenfinch	0	3		8	<34
Reed bunting	2	1	5	3	to 11
Magpie		6		15	to 32

Butterflies and moths (Ken Willmott)

With sun, frost and fog in March, sunny, drier, but mainly cooler days in April, and temperatures at or above 21°C (70°F) on only two days in May, the spring weather of 2002 was very mixed.

On 7 March the 'annual' territory of the red admiral at the northern end of Broadway Path was once again inhabited by two individuals, probably further confirmation of successful overwintering by adults. Male brimstones were also on the wing as temperatures rose to 14°C (57°F). In lesser numbers, the comma was busy establishing early territories. On 26 March, speckled wood, peacock and comma were on the wing (I. Menzies).

Early sightings of orange-tips in the first few days of April led to orange-coloured eggs being numerous on 8 May, but Bookham sightings included three females 19 May, a couple of males being seen the previous day along with green-veined whites, and a dozen purple hairstreak larvae beaten from the branches of oak (I. Menzies).

On Eastern Plain six small larvae and an egg of the brimstone were found on alder buckthorn 26 May, whilst three final instar larvae of purple hairstreak were beaten from oak, the majority having pupated.

Although it started well enough, June was an unsettled month with only brief spells of fine weather. On 26 June small skipper was just appearing, but the large skipper was numerous, an egg being found on an isolated tussock of the grass *Brachypodium sylvaticum*. Grassland with good stands of Yorkshire fog *Holcus lanatus* appear to be diminishing on the Common, small skipper sites becoming

fewer as a consequence, however there are still some good sites, particularly on the Western Plain.

The first purple hairstreak, a male, was also seen 26 June. White admirals were well out on this date too, over thirty being seen, mostly patrolling males, flapping and gliding along the edges of the trees. A male purple emperor was seen at close quarters, also on this date, in the concreted part of Ivy Cottage garden, probing the damp surface with its proboscis. Almost a dozen red admirals were seen, including an egglaying female. Another species busily utilizing the nettles was the comma, a dozen or more being seen. A single small tortoiseshell of the 'new' generation was seen and several silver-washed fritillary, including a single female. Meadow brown and ringlet were equally numerous on this date. The first female white admiral was noted two days later on 28 June.

On 13 July silver-washed fritillary populations were well up to average (I. Menzies counting thirty or forty individuals) but only a few white admirals. The population of the latter species collapsed in the poor weather conditions of the first twelve days of July, possibly leading to a smaller number of eggs being laid and a decline in 2003 numbers. Four purple emperors (average sighting) flying together at the Hill House Farm territory (I. Menzies) was encouraging after NT contractors (accidentally?) felled one of the territorial oaks, a possibly vital component of their territory structure, early in 2001. It appears that little damage has been done to the most important purple emperor site, but such work in this critical area should be vigorously discouraged, and might just have been disastrous.

A single white-letter hairstreak was seen at the south end of Bank's Path 13 July and a small larva of the eyed hawkmoth was found on sallow near Merritt's Cottage on the same day (I. Menzies and N. Anderson). On 15 July over thirty purple hairstreaks could be seen at various locations on the Common and in the Hill House purple emperor territory one was seen to be chased by a spotted flycatcher. A female purple emperor was seen flying low through the territory and fifteen silver-washed fritillaries were counted. The first gatekeepers were beginning to appear on this date.

A further white-letter hairstreak was seen on a bank of bramble at Commonside West on 20 July. Green-veined and large whites, second generation, were on the wing along with the July generation of holly blue. Six white admiral eggs were located, thankfully, but were far more time-consuming and difficult to find than in most years, at least along High Point Path and Broadway (slightly better) both of which are in need of improvement by felling a few selected oaks to increase the amount of sunlight reaching the woodland path and edges.

On 20 July female silver-washed fritillaries were seen depositing eggs on various tree trunks (especially sallow) at the junction of Broadway and High Point Paths. Half a dozen eggs were located and violets were plentiful on the ground. The gatekeeper population on this date was still all male. This species is probably the most notable exhibitor of the male population being on the wing for a period before females emerge. Only half a dozen white admirals were seen on this date, and more purple emperors were seen in the Hill House Territory.

On 10 August there were many green-veined whites, meadow browns and gatekeepers plus a single worn silver-washed fritillary (I. Menzies), and larvae of the vapourer and pale tussock moth were seen, plus a single small poplar hawkmoth larva.

The strawberry spider *Araneus alsine* (Walckenaer), on Bookham Common (Oliver Crundall and Ian Menzies)

This spectacular orb-web spider, a nationally rare species, has now been recorded from Bookham Common on four separate occasions, as follows:

1. In September 1951 two females, determined by Douglas Clark, were found by Mr D. Macer-Wright on Bookham Common (note by A.E. Le Gros, 1973).

2. A single female swept from tussocks of tufted hair-grass *Deschampsia cespitosa* in The Glade (TQ125565) on 12 October 1996 by IM.
3. A single female swept from tussocks of purple moor-grass *Mollinia caerulea* in the more acidic environment of Eastern Plain (TQ127563) on 14 October 2002 by IM.
4. Three further females were found hiding in folded birch leaves amongst *Mollinia* grass stems, Eastern Plain (TQ127563) on 23 October 2002 by OC.

Early records of this species in Surrey include Chobham Common, Box Hill (Happy Valley) and White Downs in August 1968 (Nellist 1969). The above 2002 finding of this species at Bookham suggest the possibility of a stable population in a damp *Mollinia/Calluna*-covered area with small sapling birches on Eastern Plain. Each of the last three examples were found resting in a conically-furled birch leaf at the top of its orb web fifteen or so centimetres above ground level. The body length of the female spider, excluding legs, is about one centimetre making it quite a small rotund arachnid. The entire body of this attractive spider is a glowing orange-red colour punctuated with tiny yellow dimples which, together with its shape, gives the female its characteristic strawberry-like appearance (see Frontispiece).

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Field Study Days

1. Beetles and other insects, 18 May 2002 (Leader: Maxwell Barclay)

This meeting was attended by a good number of members, as well as the Canadian entomologist François Genier, who was visiting from the Canadian Museum of Nature. The aim of the field meeting was to show the astonishing abundance and diversity of beetles attracted to the 'May blossom', the creamy white flowers of the hawthorn *Crataegus monogyna* Jacq., that bloom around a fortnight in mid to late May. Other vegetation was also beaten and swept, and a list of 101 species of Coleoptera was produced for the day (Figure 3). None of the beetles recorded was new to the Bookham Common list (now standing at over 1,500 species), but this is perhaps unsurprising because beating and sweeping in mid May has been a favourite occupation of several generations of entomologists at Bookham. A number of the more spectacular species characteristic of hawthorn blossom were found, including both steel-blue and ochreous-yellow forms of the leaf-beetle *Orsodacne lineola* (Panzer) (Chrysomelidae), and good numbers of longicorns *Grammoptera ruficornis* (F.), *Clytus arietis* (L.), *Rhagium mordax* (De Geer) and especially the striking *Anaglyptus mysticus* (L.) (Cerambycidae). Beetles noted away from hawthorn blossom included many individuals of both British representatives of the cardinal beetle genus *Pyrochroa*, *P. coccinea* (L.) and *P. serraticornis* (Scopoli) (Pyrochroidae), an example of the longicorn *Saperda populnea* (L.) (Cerambycidae), which galls the stems of young aspens, and a single female of the leaf-rolling weevil *Byctiscus betulae* (L.) (Attelabidae), beaten from aspen; this weevil was first noted on the Common in 1988 by ISM, and appears to have increased as its cogener *B. populi* (L.) has decreased. The green, dock-feeding leaf beetle *Gastrophysa viridula* (De Geer) (Chrysomelidae) was also noted in wet flushes near the Bayfield Plain. This species is very widespread across the UK, but has never been common in this part of Surrey. It was not recorded at Bookham by any of the early collectors, and was first noted in 1990 by ISM, then in 2000 (MVLB), and on 6 May 2002 (D. Prance); this is apparently the fourth Bookham record.

FIGURE 3. Field meeting, 18 May 2002. I.S. Menzies demonstrating his prototype beating tray to LNHS members, collecting beetles from heather.

Photo: M. V. L. Barclay

With reference to the Bookham Common list, the following five species were collected for which there were no post-1970 records. All were last recorded in the 1940s by Dr A.M. Easton; the dates and circumstances of his captures, extracted from his collections and notepads, are given in the table below. All five species are not uncommon nationally. The iridescent green ground-beetle *H. affinis* (Schr.) was found running on a sunlit path, the usual situation for this species. The lack of records for such an abundant insect is surprising, but may reflect the paucity of bare ground on the Common. A single example of the fungus beetle *Leiodes calcarata* (Erichs.) was collected from burdock leaves that contained large quantities of slightly mouldy frass from lepidopteran larvae. *Tachinus humeralis* Grav. and *Nicrophorus vespillo* (L.) were both collected from a single piece of dog excrement by Francois Genier, showing that even the most inauspicious pieces of habitat can yield good records. *Nicrophorus vespillo* is one of the large sexton or burying beetles, which bury small cadavers as a food supply for their larvae. Carrion traps set in September 2000 by MVLB failed to record this species, although three other members of the genus, *humator* (Gleditsch), *vespilloides* Herbst and *interruptus* Stephens, were collected. Finally, *Anthrenus museorum* (L.) was extracted from old spiders' webs in the window frames of the LNHS hut, where the species has apparently been breeding. In spite of its scientific name, *A. museorum* is seldom a pest in insect collections, that honour going, in this country, to its relatives *A. verbasci* (L.) and *A. sarnicus* Mroczkowski, neither of which has been recorded from Bookham Common.

The weather was generally good, with a few brief showers. Apart from the Coleoptera discussed above, the following other observations were made. A single specimen of the nationally scarce jumping spider *Evarcha arcuata* (Clerck) (Salticidae) was beaten from blossoming hawthorn. A cuckoo *Cuculus canorus* L. was noted calling throughout the morning; its voice was hoarse, with the traditional cuckoo-sound distorted, as though it had an obstruction in its throat. No explanation was found for this, although parasitism of some kind was suggested. At 4 p.m. an extraordinary number of jackdaws *Corvus monedula* L. were noted wheeling around the canopy of a large stand of oak trees visible from

the LNHS hut. It was estimated that there were over 200 present (Figure 4), and it was suggested that they were feeding on vast populations of lepidopterous larvae in the canopy of the trees (perhaps this was an 'away fixture' for the Richmond Park jackdaws?).

FIGURE 4. Field meeting, 18 May 2002. Flock of several hundred jackdaws *Corvus monedula*, seen from the London Natural History Society hut, Bookham Common, apparently feeding in oak canopy. *Photo: M. V. L. Barclay*

2. **Dragonflies and other insects, 13 July 2002** (Leader: Neil Anderson)

A warm day, partly sunny with a high of 22°C (72°F), was generally conducive for the observation of insect life.

Some sixteen species of butterfly were recorded; most numerous being meadow browns *Maniola jurtina* in the grasslands. Particularly welcome were about forty silver-washed fritillaries *Argynnis paphia* seen along the rides or nectaring on bramble and thistle blossom. Other notable species seen included about six white admirals *Ladoga camilla,* five purple hairstreaks *Quercusia quercus*, a white-letter hairstreak *Strymonidia w-album* on *Ulmus* by White House, and four displaying male purple emperors *Apatura iris* at a master-tree site. A first instar eyed hawkmoth *Smerinthus ocellata* larva was beaten from *Salix* by Common Road.

Odonata numbers were fairly low for the IoW chain and Bayfield Ponds. Hawkers were the most widespread anisopterans with four emperors *Anax imperator*, two southern hawkers *Aeshna cyanea,* four brown hawkers *A. grandis* and an early migrant hawker *A. mixta*. A male common darter *Sympetrum striolatum* was the only darter observed. Two male broad-bodied chasers *Libellula depressa* were patrolling IoW Pond.

A variety of the often attractively coloured chrysomelid beetles were encountered. *Chrysolina hyperici* was swept from a stand of square-stalked St John's wort *Hypericum tetrapterum*, and *C. menthastri* and *C. polita* were seen feeding on

water mint *Mentha aquatica* by the ponds. Larvae of the common green tortoise-beetle *Cassida viridis*, each bearing a pile of previously cast skins, were noted nearby feeding on the leaves of gipsy-wort *Lycopus europaeus*; reed beetles *Donacia simplex* and *D. vulgaris* were also seen, the former on branched bur-reed *Sparganium erectum* and the latter on reedmace *Typha latifolia* by the Lower Eastern Pond, and the brilliant green *Rumex* leaf-beetle *Gastrophysa viridula* was observed on dock leaves in marshy ground by Central Ditch near the IoW Enclosure.

A pine ladybird *Exochomus quadripustulatus* was beaten from *Salix*, and then, when several of the common longhorn beetle *Strangalia maculata* were being observed flying around bramble blossom by Hollow Path much excitement was caused by the arrival of *Leptura scutellata*, another large, but completely black, longhorn, which was intercepted in flight. This unexpected find is a very local ancient woodland species normally associated with old beeches *Fagus sylvatica*.

For the second consecutive year this insect Study Day has produced a hitherto unrecorded species at Bookham.

3. Grasshoppers and bush-crickets, 10 August 2002
(Leader, Ian Menzies)

Fortunately the weather was also fine for this event, and the numbers of most well-established grasshopper and bush-cricket species were well maintained. The long-winged conehead *Conocephalus discolor* was abundant in most grassy areas on the Common, but about 70 per cent were still in the nymph stage. Once again we found no sign of the short-winged species, *C. dorsalis*. Although established in at least five different areas of the Common in 1990, the latter species had retracted to only one site on Western Plain by 1994, and has not been seen since 1997. On the other hand the long-winged species, *C. discolor*, which was first noticed at Bookham about 1991, has steadily increased its range and numbers and is now abundant in all the open grassy areas.

Of the other bush-cricket species Roesel's *Metrioptera roeselii* and the speckled bush-cricket *Leptophyes punctatissima* were both quite frequent. A few oak bush-crickets *Meconema thalassina* were beaten from a single oak on the Isle of Wight Plain and the presence of the dark bush-cricket *Pholidoptera griseoaptera* was betrayed by the distinctive stridulation of the males proceeding from brambles at the margin of the rides and glades. The field and common green grasshoppers *Chorthippus brunneus* and *Omocestus viridulus* were both rather local, but the meadow grasshopper *Chorthippus parallelus* was abundant in the open grassy areas. We failed to find either woodland or rufous grasshoppers *Omocestus rufipes* and *Gomphocerippus rufus* in the areas where they had been seen last year.

Towards the end of the afternoon the party visited Wisley Common where the wood cricket *Nemobius sylvestris* and bog bush-cricket *Metrioptera brachyptera* were both plentiful. The colony of short-winged conehead was still thriving in rushes and sedges at the pond margins. We were surprise to find that several large carnivorous water-beetles *Dytiscus marginalis* had taken up residence in the limited space of a water tank at the edge of the Common.

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Book review

The moths and butterflies of Great Britain and Ireland. volumes 4(1) Oecophoridae – Scythrididae and 4(2) Gelechiidae. A. M. Emmet and J. Langmaid (Eds.). Volume 4 (1) — 326 pp., 7 colour plates, hardbound ISBN 0 946589 66 6 or softback ISBN 0 946589 72 0; volume 4 (2) — 277 pp., 6 colour plates, hardbound ISBN 0 946589 67 4 or softback ISBN 0 946589 73 9. Harley Books, 2002. Hardbound price £80 per volume or £150 if both bought as a set; softback price £44 per volume or £82.50 as a set. Available direct from Harley Books, Great Horkesley, CO6 4AH, England.

Long-overdue and split into two volumes, each of a price similar to the original predicted price for the whole, but at last we have volume 4 of *MBGBI*. So — was it worth the wait and expense?

The delay was in part caused, of course, by the sad loss of the senior editor Maitland Emmet in 2001 and these two volumes stand as a tribute to a man who was certainly one of the twentieth century's greatest microlepidopterists. He is commemorated in a most fitting tribute by the publisher on pages 7 and 8 of the first part of the volume.

The role of senior editor has been taken on by John Langmaid and if these two re-edited volumes are anything to go by then we can expect the ongoing improvements to the series to continue. We seem to have, at long last, an editor that agrees with the idea that the male and female genitalia of every species should be illustrated. The text is comprehensive, without being unnecessarily lengthy. It presents a description of the adult moth, comments on similar species, details of the life-history as far as these are known (there is a lot still to find out and these volumes serve an especially useful purpose in bringing to the attention of a wider audience of microlepidopterists the names of the species that require greater study) and distribution. The maps indicate distribution by vice-county rather than by ten-kilometre square. I have already referred to ongoing improvements. These are nowhere more evident than in the colour plate sections of the works. These plates are, quite simply, both artistically excellent and scientifically accurate; the artists, Richard Lewington and Mike Roberts, are to be heartily congratulated. However, whilst many species are distinctive, and ought to be easily named from the plates alone, many others, especially in the Gelechiidae, are confusingly similar. This is reflected in the absence of a key to adults of gelechiids based on external morphological characters. Instead, there is a key to genera based upon male genitalia, supported by excellent line-drawings and then a key to species in each separate genus based on wing pattern, colour, etc. There is no generic key to the females. Some of the characters used here are a little simple and, to an extent inappropriate. For example, there is a key to the two species of *Chrysoesthia* Hübner in part 2 (page 94), where we are invited to decide, as a means of separation, if the forewing ground colour is reddish orange or dark purplish fuscous. Frankly, this is merely repeating what is better presented in the colour plates, where the two species are distinctly different from one another. In a worn specimen (or a fresh one that someone like me has attempted to 'set'), this might be rather little use; and what about the mass of material from my Malaise traps — transparent and in alcohol! It might have been better to use less obvious characters in the key: perhaps the fact that the antennae of *C. drurella* (Fabr.) are black apart from the dark grey distal sections, whilst in *C. sexguttella* they are black with white rings around the segments. In fairness, these characters are in the text, but the identification keys seem perhaps to be directed to people who have neatly set specimens rather than real entomologists?

What is especially useful, also, is the inclusion of some very nice, clear drawings of leaf mines made by several species; I do hope that at some stage Harley Books might consider the value of producing an illustrated guide to Lepidoptera leaf mines.

It is regrettable, however, that a few errors have crept in to the two works. Some, such as the transposition of the captions to figures 8 and 9 in Plate 2 of volume 4(2), so that Fig. 8 *should* be *Aristotelia brizella* and Fig. 9 *should* be of *A. ericinella*, are indicated on an *erratum* slip issued with the books. Others are not so notified. Most are minor and of no consequence, though a very few are more important. For example, in part 2, *Coleotechnites piceaella* (Kearfott) is not mapped for VC 21 (Middlesex) in spite of this being the locality for the first (and third) British records (*vide* Ellerton, J., 1970. *Proc. Trans. Br. ent. nat. Hist.* Soc. 3: 33 – 41, a reference which is in fact cited by the author of this particular text). It is a pity, to a degree, that historical data such as the locality and date of the first British record is not a standard entry in the species texts. Surely the authors have had adequate time to do this?

A total of 309 species are covered in this two-part work, with contributions from a team of expert authors that reads like an entomological '*Who's Who*'. An introductory chapter is presented by Jens Rydell and Mark Young on the subject of *The evolution of lepidopteran defences against bats* and this is illustrated with text figures, sonograms and six colour photographs (the three of bats, in particular, by Jens Rydell are superb). However, I stand by my repeated earlier statements that these 'great' chapters have no real place in this reference work. The pages used so far almost amount to an additional volume!

So — was it worth the wait and expense? Most certainly 'yes'. Let us hope that the gap between volume 4 and volume 5 on the Tortricoidea (presumably this will also be in two parts) will not be as long as the gap between volumes 3 and 4, or we might all be dead by the time it appears.

COLIN W. PLANT

Fifty years of botany at Bookham

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Introduction

In 1942 the London Natural History Society selected Bookham Common as a suitable site for a long-term ecological survey, and work commenced the following year. Some botanical recording was undertaken but this was uncoordinated until a firm decision was made to carry out a comprehensive and detailed survey.

This first survey was completed in one year (1953) and used the services of six experienced botanists. The account of it was published in *The London Naturalist* (Jones 1954).

After some twenty-five years had elapsed it was considered that the original data was likely to be seriously out of date. Accordingly, a second survey was undertaken, starting in 1977. At this time we had fewer botanists to call on. Field recording was mainly carried out by two, with occasional assistance by other members. In an attempt to achieve some sort of parity, the second survey was continued for three years. The account also appeared in *The London Naturalist* (Radcliffe and Page 1981).

After a further twenty-five years we have brought the information up to date with a third survey, commencing in 1999. Up to nine members have participated, and the field work was terminated in 2002.

This account is intended to be comparative, drawing together all the valid data of the three surveys, and covers a period of fifty years.

The survey area

Most, though not all, of Bookham Common is covered by the area. Bookham Common extends from the edge of Bookham Village in the south to shortly beyond the Cobham Road in the north-east. This road serves as one of our boundaries. In the south a larger piece of Common is excluded, and our southern boundary is the fence of the Leatherhead to Guildford railway line. To the east, west and north-west our boundary coincides with the natural boundary of the Common.

In addition, there is an internal boundary to segregate an inhabitated area of three properties (including that of The National Trust Warden, Ian Swinney.) This piece of land is known as the 'Isle of Wight Enclosure'. It is fenced and occupies an area of 2.5 hectares (6.2 acres.)

In order to provide for some localization of records the members of the first survey subdivided the relatively large survey area into twenty smaller areas

identified individually by the letters A to T. It was found to be impossible to achieve uniformity of size of these. Firstly, the survey area was highly irregular in shape. Secondly, it was necessary to select recognizable and permanent features to denote the boundaries. The only features available were main paths, streams and ditches which were distributed in a random manner. In the course of time these smaller areas became known as, and are referred to herein as, 'divisions'.

It should be noted that the same area of survey and the same divisions have been utilized for all three surveys. One very minor adjustment initiated in the third survey was to consider divisional boundaries to be at the centre of path or stream instead of at one particular margin. This made no detectable difference to results and had the advantage of avoiding some minor difficulties of interpretation noted earlier.

In recent years it has been found possible to define the areas and centres of the twenty divisions with an acceptable degree of accuracy. Details are shown in the Bookham progress report for 1996 (Radcliffe 1997)

Collectively the twenty divisions make up a survey area of a little over 154 hectares (381 acres).

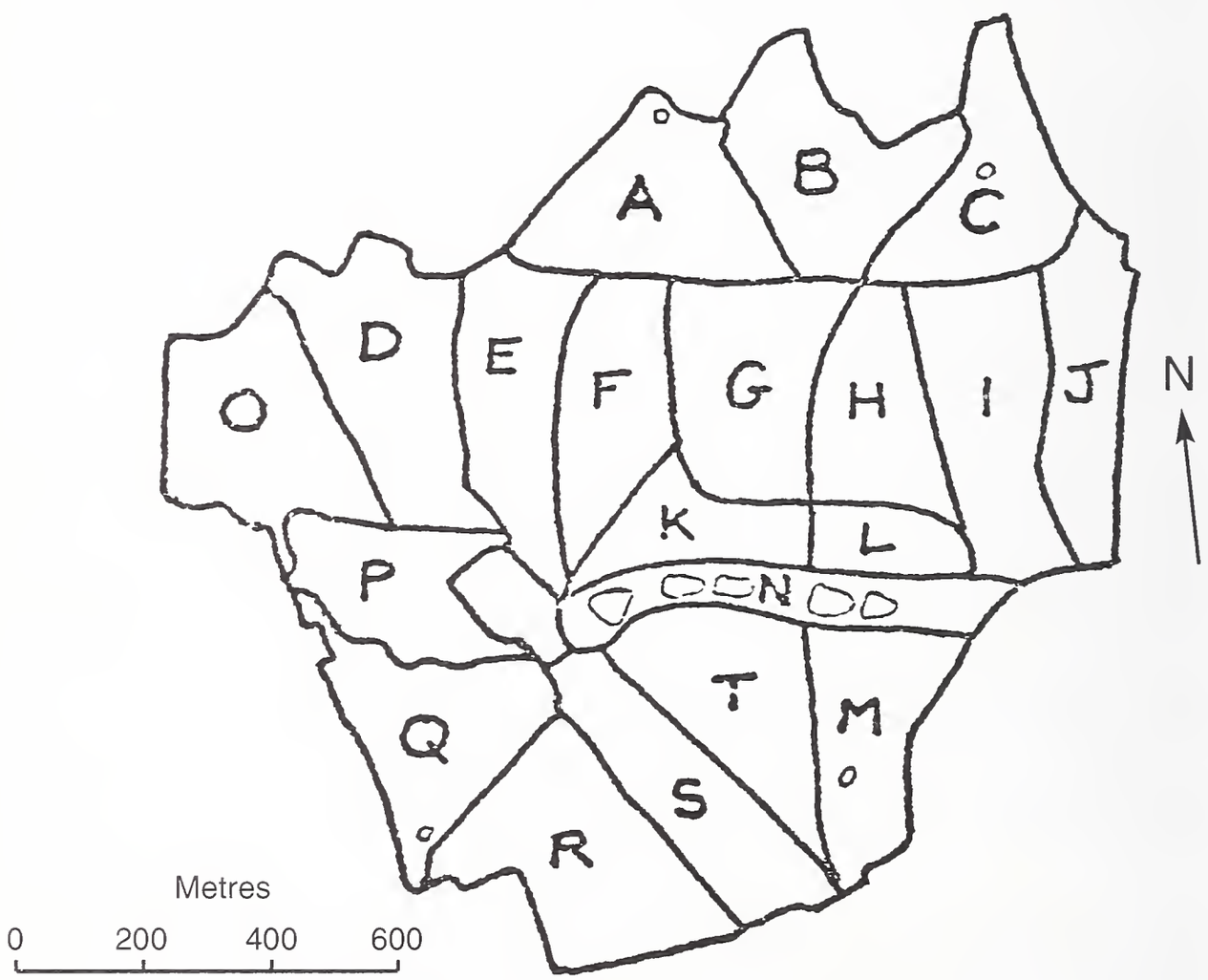

FIGURE 1. Outline sketch of survey area showing recording divisions.

The main features of the vegetation

The mid-twentieth century character of the vegetation was ably described in the 1954 account and it is convenient to follow the same sequence as adopted at that time. Many changes in detail have occurred during the fifty years but the overall pattern remains broadly similar. This is entirely due to The National Trust. Their enormous and sustained efforts to conserve the habitat deserve the highest praise.

Woodland

The principal area of woodland occurs in the north, being virtually continuous throughout divisions A to L. In the south parts of M and T have mature woodland. Next to T, division S had a significant proportion of open ground in 1953, now reduced to a thin marginal strip fringing Central Ditch. However, division S can now boast an 'Arboretum'. This was created by the National Trust for educational use; intended to contain examples of all woody species native to the Common. Individuals are widely spaced, presenting a pleasant park-like appearance, and the area is mowed annually to discourage unwanted woody intruders. Native orchids and other herbaceous plants are abundant in season.

The dominant tree of the woodlands was and remains the common oak, although this classification refers to stature rather than abundance. In some parts birch, ash and sycamore easily outnumber the oak.

By the southern boundary, Station Copse remains almost exclusively of English elm. The individuals known to the 1953 botanists succumbed to Dutch elm disease, but an unfailing supply of suckers serves to maintain the population undiminished. Suckers and young trees are not susceptible and it appears that the trees only become affected when the trunk diameter exceeds a certain size.

One area in division A has sweet chestnut well established (though probably originally planted). Since the first survey it has progressively increased to occupy further divisions. Beech also may have been planted in the past, although its headquarters are in the sole, relatively well-drained area of gravel-capped soil at High Point. Despite its stated preference for dry soils it has managed to spread since the first survey into divisions where moist soils predominate.

Hornbeam is well able to flourish in damp woodland. It was present in the first survey, and successive surveys demonstrate a progressive increase as woodland cover has extended.

Birches are in every division, giving the impression of co-existing with oak rather than competing. More about birches appears later in this account.

Two species that show signs of attempting to dominate are sycamore and Turkey oak. By the time of the third survey they were in every division, whereas in 1953 they were only in about half. The former is most abundant in the north-west of the Common where its fecund nature is demonstrated by enormous numbers of its seedlings every year. Turkey oak is most common towards the centre of our survey area in divisions G and H. Here there is an abundance of mature individuals, equalling the common oak in height, though not usually in girth. The proximity of the two oak species could contribute to an easy life for the knopper-gall wasp because these two trees host alternately its curious life-cycle. Knopper galls are a frequent sight on the Common.

Many other trees are in our area, generally of lower stature and status than the important ten already mentioned. This 'secondary' group numbers thirty-seven, of which nineteen are new to the Common since the first survey. Seven of the recently acquired taxa are hybrids.

There has been a general and significant increase, not only in the number of kinds of tree, but in the number of divisions occupied. Five of the 'secondary' group, somewhat localized in the first survey are now in every division.

All of the trees are included in the species list, and it will be seen that the symbols employed reveal the records in each survey.

The Plains

This second major part of the survey area encompasses divisions O,P, R and most of Q. These are contiguous and at a low elevation, crossed by streams and ditches. At a somewhat higher level, Eastern Plain occupies much of division T and part of M.

In former times most , if not all of this terrain was in use by farmers for stock grazing of various types, and it would have been virtually all grassland. However this practice declined progressively and had ceased completely by the middle of the twentieth century. At the time of the first survey in 1953 the succession to scrubland had begun. The account mentions 'small bushes all over the plains'. Nevertheless, it still was essentially grassland and areas of tufted hair grass, purple moor grass and false oat grass were considered worth highlighting.

Despite the valiant efforts of The National Trust the battle can only be won over a limited area for a brief period. The plains have been transformed from 'grassland with a little scrub' to 'scrubland with a little grass'. The three grasses mentioned (and many others) are present but their areas have been severely fragmented. Hawthorn, blackthorn and sallows matured rapidly, while maturing oak, ash, crack willow, etc. add a new dimension to the scene. Young woodland occupies much of division O and the formerly open part of D is similarly submerged.

Eastern Plain remains substantially as it was in 1953, except that the small part of it across the divisional boundary in M has succumbed to young woodland. Birches are frequent, but the substantially open character has been well preserved. The principal threats to the Plain are aspen and bracken, and measures to curb their invasive tendences are required every few years.

Common species of the plains, as tabulated in the 1953 account, remain common; some becoming more so. More localized species such as common and dwarf gorse have lost ground. In the case of petty whin we regret to report the complete loss of this attractive little shrub. Nine divisions in 1953 were reduced to two in the 1970s and nil in the third survey,despite special searching.

The decline in heather has been similar though not as drastic. Six divisions in 1953 are now reduced to two. Eastern Plain is the only site where it remains locally frequent. It is of some interest to record that an experimental scrape on a heather-free part of the Plain by a mechanical digger resulted in the appearance of a number of heather seedlings. Heather seeds can obviously remain viable in the soil for a period.

Water features

London Clay is the geological formation that dominates the soils of Bookham Common despite the small gravel capping at High Point and a rather larger area of alluvium fringing the water-courses in the west. Soils are typically moist for most of the year.

The most important wet area is in division N, where a chain of interconnected ponds (some might describe as lakes) run east to west halfway across the Common. The chain is fed from a permanent stream known as Greendell Ditch.

In medieval times the ponds were controlled by Chertsey Abbey, to provide fish for its members. In the succeeding centuries changes of ownership and neglect combined to produce a marked deterioration, so by the beginning of the twentieth century the third and fourth ponds had become moist 'hollows' invaded by woodland. This state of affairs existed at the time of the 1953 survey. However, in 1977 The National Trust undertook the massive task of restoration and the work was completed in one year. Recolonization by aquatic plants was rapid and the second survey was able to benefit from this.

The chain of ponds is named : Upper Eastern, Lower Eastern, Eastern Hollow, Western Hollow, and Isle of Wight Ponds.

Four medium-sized, widely separated ponds occur, these being Kelsey's, Sheepbell, South-East and Bayfield Ponds. All have, or have had, plants of interest.

Considering the minor ponds, some have been lost since the first survey. The two more southerly Mark Oak ponds have disappeared, though the remaining

one has recently been dug out. West Pond, near Bookham Stream in division Q has gone. Banks Pond at the tip of P had already lost its standing water in 1953, although tubular water-dropwort survived at that time. The only plant of interest there now is common polypody, epiphytic on a willow. Crater Pond, not mentioned in the first survey has undergone several cycles of loss and restitution.

Curiously, Manor Pond, just south-west of the Isle of Wight Enclosure has increased in size. It is fed by a continuous inflow from Central Ditch. It is thought that at some time before the second survey the outflow became impeded, with the result that the pond spread over the adjacent low ground. Originally small, the pond now occupies several hundred square metres. Central Ditch reappears downstream.

The stream issuing from Isle of Wight Pond traverses one of the properties in the Isle of Wight Enclosure and merges with Central Ditch and Isle of Wight Ditch (both permanent streams) to become Bookham Stream. This takes a wide sweep to the north forming the divisional boundary between P and Q. Banks Stream enters division O in the far west, flowing north and merging with Bookham Stream before the combination leaves the Common at Hundred Pound Bridge.

Some essential revisions

The last two decades of the twentieth century brought an enhanced awareness to amateur botanists of species delimitation, particularly in relation to the occurrence of hybrids. Unfortunately, the first two surveys at Bookham preceded this era. We now know that three plants determined then as species were in fact entirely or mainly hybrids. It is necessary to set the record straight and we deal below with the taxa involved.

Juncus acutiflorus / *J.* × *surrejanus*

The hybrid of *Juncus articulatus* and *J. acutiflorus* was first described as long ago as 1929 from specimens that had been collected in Surrey some forty years earlier. This news was apparently ignored by Surrey botanists for many years, although occasional records were made elsewhere in the UK.

In 1981, when looking at various rushes, we were surprised by the absence of seed in what appeared to be *J. acutiflorus*. Closer examination revealed that these plants were in fact *J.* × *surrejanus*. A wide ranging search showed that the true species was quite limited in quantity, and its colonies were greatly outnumbered by those of the hybrid. This was found to be repeated when we examined other Surrey colonies away from Bookham.

The hybrid is evidently somewhat variable in appearance. A study in north Wales (Blackstock and Roberts 1986) described it as resembling *J. articulatus*. At Bookham we find the converse to apply, so that it more closely resembles *J. acutiflorus*. We find the resemblance such that we only accept identification if presence or absence of significant seed content is included.

Although highly sterile the sterility is not absolute. The occasional plant is found in which one, or rarely, two seeds occur in a single capsule, among the hundred or so empty capsules. This may be contrasted with *J. acutiflorus* where about twelve seeds may be expected in every capsule.

A feature of the hybrid, noted by several authors and evident at Bookham, is the ability to proliferate in autumn from nodes of the stem and axes of the flower heads. An effective method of vegetative propagation is therefore available to compensate for infrequency of recruitment from seed.

In divisions where we earlier recorded the species, we now have records of the hybrid in the absence of the species, so all previous records become suspect.

Betula pubescens / *B.* × *aurata*

During the second survey we relied on the simplistic assumption that a birch with hairy yearling twigs must be *Betula pubescens*. Such trees are widespread and common in the area , with the result that *B. pubescens* was recorded in every division.

Later, under more critical scrutiny, it was noted that a wide spectrum of degree of hairiness occurred. Furthermore, a spectrum of varying numbers of warts existed on the twigs (a character associated with *B. pendula*.) We are now obliged to conclude that these trees are not *B. pubescens* but *B.* × *aurata*. In support of this we cite a study by Kennedy and Brown (1983) in which known hybrid trees possessed both hairs and warts, while those of *B. pendula* had warts without hairs and *B. pubescens* had hairs without warts.

Despite prolonged searching we have been unable to find a single individual tree having hairs without warts, and we believe that *Betula pubescens* does not now occur on Bookham Common.

The hybrid is clearly fertile because its saplings, although not quite as abundant as those of *B .pendula* are widespread, and in every division.

The frequency of naturally occurring hybrid birch has been doubted by some authors; but it may be of some significance that their investigations have been confined almost exclusively to Scotland and the more northerly regions of Europe. It is possible that the milder climate of southern England has had some influence in promoting hybrid generation.

Prunus spinosa / P. × *fruticans*

In the 1953 survey *Prunus spinosa* was recorded in eighteen divisions. In the second survey it was recorded in all twenty. The hybrid was not sought in either survey.

Although A.C. Leslie (1987) made reference to the hybrid in his *Flora of Surrey* Supplement, there was no recent record to report. However, in the 1990s interest was beginning and records were being made. When we embarked on the third survey an early decision was to give Bookham's blackthorns special attention.

In the absence of obvious morphological differences between species and hybrid it was thought that the shape of the stone within the sloe might be reliably diagnostic. In *P. spinosa* the stone is approximately spherical. The hybrid stone deviates significantly, presenting two partially flattened surfaces separated by a more or less prominent ridge (in effect tending towards the shape of stone of *P. domestica* the other parent, though on a much smaller scale).

One of our members, Roy Sherlock, undertook the very onerous task of obtaining the necessary data to elucidate the problem. He took samples of ripe sloes (four per bush) from a very large number of blackthorns, cleared away the flesh, then made accurate measurements to tenths of a millimetre of length, width and depth of each stone. His investigation was not confined to Bookham but covered many other sites in Surrey and other counties.

A surprising finding was an enormous variation in dimensions of the cleaned stones. Depths varied by up to 70 per cent, widths up to 96 per cent and lengths well over 100 per cent. One implication from this was that we were not simply confronted by a primary hybrid but a large range of back-crosses, and some or all of these must be fertile.

Some stone samples approached more or less closely to the spherical form, and it was necessary to seek a discriminant condition between species and hybrid. A useful method of assessing the symmetry of a three-dimensional body is to calculate a value of the root-mean-square (RMS.) This is derived by the formula:

$$\mathrm{RMS} = \sqrt{\frac{(l\text{-}w)^2+(l\text{-}d)^2+(w\text{-}d)^2}{3}}$$

where l = length, w = width, d =depth

With a perfect sphere or perfect cube the RMS would be zero. Biological systems do not produce perfect results and no sloe stone is ever a perfect sphere.

It was therefore necessary to make allowance for natural irregularity. The decision was made to set a provisional level of RMS at 1.5. We hasten to point out that this level is based on no good evidence, and can readily be raised or lowered if further work suggests its need.

Using the provisional discriminant of 1.5, four individuals having a lower value were recorded on Bookham Common and are therefore assigned to *Prunus spinosa*. they were mostly remotely separated, and were in four divisions. A large majority of the stones had RMS values in excess of 1.5 and were considered to be referable to *P.* × *fruticans*.

It is necessary to make it clear that although 'blackthorns' occur in all twenty divisions of our survey area, many do not fruit and therefore cannot be identified. We do not know whether this is a consequence of natural sterility or excessive shade. The latter is thought to be the case with most individuals. In some of the heavily wooded divisions no fruit could be found, and this is no doubt the reason why *P.* × *fruticans* was only recorded in thirteen divisions.

Although we have entered four *P. spinosa* and thirteen *P.* × *fruticans* in the species list we have done so with little real confidence. Our doubts are based on the fact of the very wide range of stone dimensions recorded. Such a range appears incompatible with the notion of total control of the stone by the female parent. If, as seems possible, a more complex set of genetic factors is involved then the fruit would frequently not be conspecific with the parent plant. It may be the case that further progress with the blackthorn problem will have to await DNA evidence.

We should point out that Roy Sherlock's large body of data is available for anyone who has the time and inclination to seek answers.

In view of the foregoing corrections to the misidentifications of previous surveys we must make amendments to compensate. Accordingly, in the species list that forms an appendix to this account *Betula* × *aurata* is inserted and *B. pubescens* deleted. Similarly, earlier records of *Juncus acutiflorus* and *Prunus spinosa* are deleted. Only records of these made in the third survey appear in the list.

It will be observed that species of *Rubus* are also omitted. The genus is considered to be of sufficient variety and importance here to merit a separate paper. Ken Page has prepared a comprehensive account of all *Rubus* species and microspecies recorded on the Common, and this appears later in this issue.

Nomenclature

The layout of the species list necessitated some thought, owing to the need to present a great deal of data in a limited space. It was considered desirable to provide vernacular names for the benefit of those having little familiarity with scientific names but the size of the former did in some cases compel the use of abbreviations. These are given preceding the species list.

It will be seen that we have broken with tradition in the sense that plants are sequenced, not in systematic order, but by genus, species and hybrids. It is believed that modern preference is to refer quickly to a particular plant, rather than remember to which family it belongs, then where in the sequence that family appears. Such information may be of interest, but of lower priority, for which a Flora may be consulted.

All names follow Stace (1997).

General comparison of surveys

The three surveys can be readily compared by reference to Table 1.

In the second survey it had been noted that 379 species were common to the first two surveys. At the close of the third the number common to all was 338; a shortfall of 41. This reveals a greater loss than that between first and second (25) and suggests an accelerated change in the habitat. However new species actually increased the tally in the third survey.

TABLE 1. General comparison of surveys. Totals amended where necessary to eliminate possible misidentifications.

		1st survey	2nd survey	3rd survey
Number of species/hybrids recorded		459	434	491
Number of species/hybrids unique to one survey		66	29	86
Number of species present in all surveys		338	338	338
Combined total of all species/hybrids recorded				617
Species/hybrids recorded in all 20 divisions		12	24	55
Records lost by species common to all surveys				583
Records gained by species common to all surveys				1,120
Records of 1st survey only	579	579		
Records of 2nd survey only	232		232	
Records of 3rd survey only	1,068			1,068
Records of 1st and 2nd surveys only	221	221	221	
Records of 1st and 3rd surveys only	334	334		334
Records of 2nd and 3rd surveys only	493		493	493
Records common to all surveys	1,957	1,957	1,957	1,957
Total records 1st survey		3,091		
Total records 2nd survey			2,903	
Total records 3rd survey				3,852

(1st survey total includes 56 noteworthy records made before that survey)

Comparing third and first surveys, the increase of approximately 25 per cent in total records greatly exceeds the 7 per cent increase in species seen. This can in part be attributed to the longer period of the third survey, but is also indicative of increased occurrence of species already common.

The number of species occupying all twenty divisions of the survey area increased in a spectacular manner over the fifty years (12, 24, 55). We do not know whether special efforts were made to fill in 'gaps' during the first survey. We do however know that such efforts were made in the second and third surveys, and that in respect of these later surveys the totals of 24 and 55 are reliable. This serves to reinforce the notion that common species are becoming more common at Bookham.

After the second survey it was noted that, of species recorded in both surveys, 770 divisional records had been lost and 638 gained. It was inferred from these figures that significant translocation ('migration') had taken place about the Common in various directions. Now that equivalent values relating the third and first surveys are available (583 divisional records lost and 1,120 gained) we are able to confirm that the trend continues. Its magnitude is discussed later in this account.

Comparison of surveys at species level

In the course of fifty years it is inevitable that there will be many changes in detail to the flora of an area. The natural succession alters habitats radically, rendering the terrain less suitable for some and more suitable for other plants. Wild mammals, birds and insects all have an effect that is substantial, although not always obvious. Visitors, together with their horses or dogs, produce changes, either positively by introductions, or negatively by trampling, Lastly,

the very act of conservation work imposes deflections on the natural course of succession, and certainly redistributes species, even sometimes introducing new species if the machinery has been used elsewhere.

The trend, noted in the account covering the second survey, has continued broadly in the same direction in the third survey. It is confirmed that vigorous and common species continue to increase their range and abundance while less-common species become rare or extinct.

In the next part of this account, three numbers in brackets following a species name indicate the divisional records made in the (first, second and third) surveys.

Total losses of native species

A large number of species have disappeared completely. Many occurred as single individuals, sometimes present as 'casuals', and their loss should not cause too much concern. Examples can be seen scattered throughout the species list.

More significant losses are: *Pilosella officinarum* (13,3,0); *Bidens cernua* (9,2,0); *Genista anglica*(9,2,0); *Leontodon hispidus* (8,1,0); *Pimpinella saxifraga*(6,2,0) *Euphrasia nemorosa* (5,0,0); *Aphanes arvensis* (5,1,0); *Ranunculus bulbosus* (5,2,0); *Thymus pulegioides* (5,0,0); *Sinapis arvensis* (4,0,0); and *Papaver rhoeas* (4,0,0). It is likely that these losses are in the main due to increased shade of the habitat.

Considering grasses, it is often difficult to be sure that these relatively inconspicuous subjects have really gone but almost all have apparently been absent since the first survey. They include: *Brachypodium pinnatum* (1,0,0); *Briza media* (4,0,0); *Bromopsis erecta* (1,0,0); *Festuca ovina* ssp. *ovina* (4,1,0); *Koeleria macrantha* (4,0,0); *Trisetum flavescens* (7,0,0); and *Vulpia bromoides* (4,1,0).

All of these grasses are light-demanding, and the more calcicolous of them were probably casual only, present as a result of temporarily abnormal soil conditions on the Common.

The lone asparagus plant that by the time of the second survey was reckoned to be thirty years old was last seen about 1990. Having reached the age of at least forty it was finally obliterated by woodland growth.

Reductions of native species

Some species, generally common in the UK, though less so at Bookham are losing ground. Several of the following are in danger of being completely lost before long: *Stachys officinalis* (15,11,5); *Campanula rotundifolia* (9,4,1); *Viola canina*(5,1,1); *Rumex acetosa* (19,16,13); *Lotus corniculatus* (14,11,7); *Achillea millefolium* (13,10,7) *Achillea ptarmica* (13,8,8); *Potentilla anglica* (8,6,1); and *Lathyrus linifolius* (6,3,1).

Alisma plantago-aquatica (15,3,6) suffered severely between the first and second surveys but has experienced a partial recovery at the moment, mainly due to conservation work on Kelsey's and Crater Ponds.

Fragaria vesca (17,8,6) continues to decline slowly. As pointed out in the account of the second survey the species though tolerant of shade is not really at home in woodland with an acid soil. Until shortly before the first survey it had been customary to use chalk to repair paths. We believe this practice was responsible for introduction and maintenance of the strawberry. No chalk has been applied since 1950, and the residue has gradually leached away, causing a reversion to acid conditions.

The temporary presence of *Silene vulgaris* and *Lithospermum officinale* during the first survey may also have resulted from path repairs with chalk. *Cephalanthera damasonium* (a strict calcicole) appeared briefly, on chalk rubble, during the second survey.

Increasing species

Carex pendula (1, 5, 16) started as a single record in the first survey; increased moderately in the next twenty-five years and then rapidly in the succeeding twenty-five. Many recent records are by or close to paths, and it seems likely that human activity is to some extent responsible, perhaps inadvertently. It is certainly the case that the species has found some popularity as a garden subject in recent years.

It is understandable that *Cardamine flexuosa* (5, 12, 20) should find conditions more to its liking than *C. hirsuta* (2, 7, 12) because shady spots are plentiful even in the more open divisions. *C. hirsuta* can sometimes be found on pathways getting a modicum of sun in an otherwise shady division.

Arctium lappa (4, 5, 17) and *A. minus* (6, 6, 14) seem to have found conditions particularly favourable since the second survey. Like *Carex pendula* they tend to be found by pathways, and likely vectors are dogs, horses and trousers.

Various ferns have fared particularly well over the fifty-year period. *Dryopteris filix-mas* (16, 20, 20) and *D. dilatata* (11, 20, 20) were found to be ubiquitous by and after the second survey. *D. carthusiana* (4, 14, 17) recorded with some hesitation in the first survey now occupies most of the divisions. The increase of *Athyrium filix-femina* (1, 6, 11) is remarkable. *D. affinis* (0, 2, 8) is present as both ssp. *affinis* and ssp. *borreri*. *Polystichum setiferum* (2, 3, 5) increases steadily. *Polypodium vulgare* (0, 0, 2) was a new find in the third survey, although possibly present unseen before. The two plants are remotely located, one epiphytic, one terrestrial. *Phyllitis scolopendrium* (0, 2, 2) has occurred in four divisions, two subsequently lost, two extant. *Polystichum aculeatum* (0, 0, 1) turned up in the third survey, remote from any habitation. Currently we are unable to relocate it, probably due to the impenetrable nature of the surrounding undergrowth.

The abundance of shade, moisture and a mildly acid soil clearly suit the range of ferns we have, and *Dryopteris carthusiana* may well become ubiquitous in the near future, possibly followed by *Athyrium filix-femina* later. Our soil is probably not sufficiently acid to support *Blechnum*, *Osmunda* or *Thelypteris*.

As might be expected, shade-tolerant grasses such as *Bromopsis ramosa* (10, 14, 19), *Festuca gigantea* (4, 10, 17), *Holcus mollis* (0, 7, 9) and *Melica uniflora* (2, 1, 7) made a good showing. Surprisingly, some sun-loving grasses such as *Agrostis capillaris* (12, 16, 20), *Agrostis stolonifera* (8, 9, 20), *Anthoxanthum odoratum* (16, 17, 20) and *Arrhenatherum elatius* (15, 16, 20) were ubiquitous in the third survey.

Of interest was the substantial increase of *Crataegus laevigata* (3, 8, 15). Its hybrid *C.* × *macrocarpa* (0, 1, 5) increased also. The latter may well be under-recorded, but it was beyond our powers to examine every hawthorn in 150 hectares!

Rosa arvensis (8, 15, 19) and *R. canina* (7, 11, 17) have increased greatly over the last fifty years. It is a matter of some surprise therefore that division C, apparently very suitable, has no rose of any sort.

An interesting individual example of *Rosa arvensis*, present on the side of Hollow Path for many years has double flowers, i.e. with two whorls of petals.

The first survey recorded *Rosa rubiginosa* in division E. This is a very unlikely record for an area with acid soil and it seems possible that this may in fact have been *R. micrantha;* in an era when the small differences between the species were less well known. *R. micrantha* is certainly now present in division E as well as in the adjacent K and N.

Juncus tenuis (2, 2, 14), which marked time until the last twenty-five years is now in many more divisions, always associated with paths, and clearly spread by walkers and horses.

Hyacinthoides nonscripta(11,13,20) and *Arum maculatum,* (9, 16, 18), common inhabitants of woodland, both increased their divisional tally by nine over the period. It is strange that the *Arum* has never been recorded in two of the central divisions that appear eminently suitable, and surrounded by divisions that carry the species.

Populus tremula (10, 14, 20) became ubiquitous in the third survey. Its spread is not always by seed, because it can infiltrate by sub-pathway roots and suckers. This was observed between divisions D and O.

After the second survey we commented on the apparent inability of *Oxalis acetosella* (14, 14, 15), another abundant woodland plant, to colonize adjacent woodland areas. We must now retract this by noting its acquisition in division L. A single plant was found, having taken at least fifty years to get across the boundary.

Many other instances could be cited of species undergoing significant expansion or contraction of range and frequency but it is appropriate to limit the comments to those given above. Readers having an interest in particular species will be able to trace any pattern of change by reference to the species list.

Species fluctuating in frequency

Three species exhibited this tendency to a significant extent. *Cirsium palustre* (20, 15, 20) and *Ranunculus flammula* (20, 16, 20) were ubiquitous in the first and third surveys but apparently disappeared from several divisions in the second survey. They were both searched for in the missing divisions. Both are conspicuous and readily recognizable species, and we are quite unable to account for the absences.

The third species, *Chamerion angustifolium* (18, 20, 12), became ubiquitous in the second survey but since then has apparently lost eight divisions. It might be contended that this could be attributed to increased shade. This might in one or two cases be possible but not in eight. No divisions are completely devoid of lighter areas, and several have significant open ground. Non-flowering individuals of *Chamerion* are not difficult to identify. It is an odd puzzle.

Unwelcome species

Impatiens glandulifera was not on the Common at the time of the first survey, but from the second survey onward has become an insidious menace. In the first year of the second survey it had a modest footing in P and Q. Before the end it had spread downstream into O and upstream into R. By the beginning of the third survey it had crossed Central Ditch into S, and spread from O into the lower ground of D.

In the north of our area it first appeared in C (probably a separate introduction, possibly with garden rubbish) but a sustained effort of hand-pulling by working parties has failed to prevent its appearance in the adjacent J.

We suspect that the sudden influx of five plants of *Heracleum mantegazzianum* is the result of human intent. The plants all appeared over a brief period in the third survey in well-spaced locations. We intend to ensure that the plants are eliminated before seeding.

Crassula helmsii is a serious weed in and around water bodies, as many garden-pond owners have discovered to their dismay. We were pleased to note that a big effort to eradicate it by excavation work on South-east Pond has been successful. More worrying is the discovery of it in the main chain of ponds, where its destruction may well prove impossible.

Fallopia japonica has been with us since the 1953 survey, in the extreme east of the area. Fortunately it seems unable to spread, and the small area covered has apparently diminished since the second survey.

We are keeping an eye on *Rhododendron ponticum* noted first in the third survey, but from the size of the two bushes, possibly present before. The likely source is nearby gardens, but since the bushes are struggling against thick woodland they are unlikely to pose a real threat.

Buddleja davidii is another newcomer that will need watching, but is not expected to be troublesome in our very wet soil.

A somewhat surprising possibility of a problem emerges with the spread of the hybrid *Salix* × *rubens* 'Basfordiana'. In the 1970s The National Trust

planted a line of saplings of this hybrid in division S close to Central Ditch. The saplings have now become mature trees, and are undoubtedly attractive in winter with their reddish-orange twigs. However, the twigs inherited another character from *Salix fragilis* ; their fragility. Twigs detached by wind have blown across Central Ditch into division R and taken root. Some are now four metres high. Other twigs, falling into Central Ditch have been carried downstream and are colonizing division Q. This form of the hybrid has also appeared in division N, though it is difficult to understand how this could have happened without human help.

Other plants worthy of mention

Pulmonaria mollis is distinct from the better known *P. officinalis,* though rarely grown in gardens, so it was a surprising find in division D. A small fragment propagated in KP's garden has prospered, and reproduces well by seed. The only doubt with this plant is whether the specific name will survive. The plant is a member of a confused section of *Pulmonaria* whose future is under review by European botanists.

Cynoglossum germanicum also turned up in division D, first as a single plant, latterly about twenty. This species was formerly regarded as an obligate calcicole, because it was known, and very rarely, only on chalk soil. This notion was disproved when it was found growing on the acid soil of Leatherhead Common, where many thousands of individuals occur. Leatherhead Common, scarcely more than 3 km away from our area, was probably the source of the plant, but what was the vector? Dog? Fox? Deer? Human? We shall never know unless it was human and a confession is forthcoming.

We have refrained from entering *Tilia americana* in the species list because we are not yet completely certain of its identity, though it seems a very good match. A definitive answer will be possible when the tree reaches flowering age.

Just outside Ian Swinney's garden is *Akebia quinata,* having insinuated its way through the hedge. No fruit (resembling a purple cucumber) has been seen, but the plant has rooted copiously and is competing successfully with a bramble patch. It is currently starting to climb a birch tree.

Finally we come to a putative hybrid, whose identity is in dispute. Two *Agrimonia* species, *A. eupatoria* and *A. procera* are common at Bookham. The team believe we have a plant of the hybrid *A.* × *wirtgenii* in the area. This hybrid has only been acknowledged once in the UK, in Northumberland in the 1940s.

A chromosome count by the University of Leicester produced 2n=56 (the same as diploid *A. procera*) and the University pronounced the plant to be *A. procera.* Our belief is that diploid *A. procera* must have hybridized with tetraploid *A. eupatoria* to produce the observed chromosome count.

Our plant regularly grows to twice the height of *A. procera* and continues flowering very late in the season. It consistently fails to set a single seed, in contrast to an *A. procera* plant two metres away which always fruits normally. A plant in KP's garden, propagated from a root cutting shows identical behaviour.

Migration

At the close of the second survey it was realised that a substantial shift had occurred in the centres of distribution of species since the first survey. In an attempt to quantify this movement a technique of calculation was devised using the co-ordinates of the National Grid and featuring a selected list of species that were abundant in the survey area.

Initially, the calculations had included *Betula pubescens.* When this was found to be incorrectly named (and we did not know its status twenty-five years earlier) we were obliged to omit it from the list which became reduced to fifty species.

Full details of the method of calculation and the revised results are given in the Bookham progress report for 1997 (Radcliffe 1998). For those wishing to check out the findings, centre co-ordinates of all divisions are listed in the progress report of the previous year (Radcliffe 1997).

Turning to the third survey it was again evident that movement had continued in the second twenty-five years, but before we could embark on another series of calculations it was necessary to resolve a problem. Certain species had ended up with symbols of 1 and 3 in one or more divisions, that is, they had been recorded in the first and third surveys but not in the second survey. We had no way of being certain that true loss followed by recolonization had occurred, or that the species had been present unobserved in the second survey. The decision arrived at was that we should disqualify such species.

The criteria for inclusion were therefore amended as follows:

1. The species was not present in all divisions in all surveys.
2. Inclusive of all surveys, the species was present in at least seventeen divisions.
3. Species unrecorded in any division in the second survey, while recorded in that division in both first and third surveys were disqualified.

This further restriction eliminated twenty-four species, and *Prunus spinosa* was also removed. However, increased frequency over the twenty-five years enabled eighteen new species to qualify, and the final eligible total was forty-three. The migration calculations were performed on these and the results are shown in Table 2.

It will be seen that centres of distribution have moved in all directions of the compass and there is undoubtedly a random element in the movement. In the absence of any external directional influence the dispersion would be expected to be totally random. In this event the algebraic summation of all displacement would have tended towards zero or a low value. However, this clearly is not the case, because algebraic summation indicates a very substantial movement in the south-west quadrant.

The reason for this movement is easily appreciated. The relatively open areas to the south and west provide sites for colonisation by new species, whether shade-tolerant or light-demanding.

The revised calculations after the second survey (Radcliffe 1998) show a nett overall movement of 1,658 metres by fifty species in twenty-five years. From Table 2 it will be seen that forty-three species moved 2,835 metres in fifty years. Simple reduction of these two sets leads to 1.32 and 1.31 metres/species/year respectively. Furthermore, if we look at the other group of species in the 1998 report (species having fourteen to sixteen divisional records), the nett overall movement was 1,696 metres by fifty-one species in twenty-five years, and this on reduction provides a figure of 1.33 metres/species/year.

It would be inappropriate to attach undue importance to these remarkably similar findings. The actual rate of movement could be expected to differ widely in response to various factors, including the nature and size of the terrain and the extent of human interference. The density of pre-existing vegetation on the open area would be very important.

The close similarity of results despite a very different mix of species is surprising, and provides some encouragement for the notion that it may be possible to formulate some sort of 'migration index'. If this became a reality it might be a useful tool in biogeographical studies. Perhaps a start could be made utilizing a section of recently set-aside agricultural land that adjoined substantial woodland, monitoring the dispersion of woodland species into the open land. It would be necessary to subdivide both open land and woodland into recognizable blocks, preferably uniform in shape and size. Clearly, a considerable amount of work would be required to determine whether a migration index could become a reality.

TABLE 2. Migration over fifty years, 1953 to 2002.

	Centre shifts (metres) East	West	North	South	Diagonal move (m)	Bearing degrees	Individual quadrant
Acer campestre	54.9			66.5	86	140	SE
Acer pseudoplatanus	54.1			122.1	134	156	SE
Agrostis capillaris		12.8	159.3		160	355	NW
Ajuga reptans		77.6		11.2	78	262	SW
Arum maculatum		5	74.4		75	356	NW
Betula pendula		68.1		3.7	68	267	SW
Callitriche stagnalis	3.7			69.4	69	177	SE
Carex hirta	73.9		2.8		74	88	NE
Carex sylvatica		202		109	230	242	SW
Chamerion angustifolium		106.4		196.7	224	208	SW
Circaea lutetiana		105.6		71.5	128	236	SW
Corylus avellana		83.5		40.6	93	244	SW
Dryopteris carthusiana		1.8		296.9	297	180	SW
Dryopteris dilatata		33.4		172	175	191	SW
Dryopteris filix-mas		80.1	16.6		82	282	NW
Epilobium ciliatum		274.3		195.7	337	234	SW
Epilobium montanum		88.1	59.5		106	304	NW
Fagus sylvatica	22.3			57.5	62	159	SE
Festuca gigantea	341			297.8	453	131	SE
Fraxinus excelsior	20.5			82.1	85	166	SE
Hedera helix		38.1	5.1		38	278	NW
Hyacinthoides nonscripta	22.1			93.8	96	167	SE
Ilex aquifolium		83.5		40.6	93	244	SW
Juncus effusus		0.2		3.3	3	183	SW
Lycopus europaeus		59.6		137.3	150	203	SW
Malus sylvestris		141.6	9.4		142	274	NW
Moehringia trinervia		67.8		22.7	71	252	SW
Persicaria hydropiper		17.7		92.2	94	191	SW
Poa annua	8		15.7		18	27	NE
Populus tremula		113	14.5		114	277	NW
Potentilla sterilis	29.1		9.6		31	72	NE
Quercus cerris		77		210.5	224	200	SW
Rosa arvensis	5.9		53.8		54	6	NE
Rumex acetosa		130.7		137.8	190	224	SW
Ruscus aculeatus	2.9			15.3	16	169	SE
Salix caprea		152		18.6	153	263	SW
Sambucus nigra	21.8			15.3	27	125	SE
Scrophularia nodosa	68.6			44.4	82	123	SE
Stellaria graminea		30.2		29.7	42	226	SW
Stellaria uliginosa		317.2		138.3	346	246	SW
Urtica dioica	35.7		22.2		42	58	NE
Veronica chamaedrys	10.9		28.8		31	21	NE
Viola riviniana		20.1		11.5	23	240	SW
	775	2387	471.7	2804			

Nett displacement 1612 west 2332 south

Nett combined diagonal move 2835 metres

Tangent 1.477 angle 55 degrees

Resultant bearing 215 degrees in SW quadrant

A final summary

In the past fifty years at Bookham considerable changes have occurred in the flora. Species initially of restricted distribution have generally declined in frequency. Some have been completely eliminated: others are perilously close. Most would be broadly classified as light-demanding.

This decline is in stark contrast to the increase in frequency of common plants, particularly demonstrated by the spectacular change in the number of ubiquitous species. No doubt there is some degree of linkage between the phenomena.

Many of the newly increased species are shade-tolerant (e.g. ferns) but a surprising number are usually regarded as preferring lighter conditions. Examples are *Cerastium, Juncus bufonius, Juncus tenuis, Lapsana* and several grasses. It seems probable that these are truly opportunist species : their seeds benefiting from a free ride on muddy boots and hooves, and then able to germinate and flower in a reasonably short period.

The formerly unsuspected but widespread occurrence of hybrids proved to be a significant factor in the third survey. Future surveys elsewhere will need to give attention to this development.

The migration of species in a south-westerly direction was shown to have continued. This must inevitably diminish as the years go by, and eventually cease. No diminution is evident however, over the last twenty-five years.

Readers contemplating the possibility of joining the Bookham Survey team should not be discouraged by the fact of the loss of a few plant species. This happens everywhere and should be regarded as a logical expression of the dynamic character of succession in the environment. There is still a vast amount of work to be done and there is no shortage of species to study. It should be remembered that the third survey ended with more species recorded here than ever before.

In common with all other branches of natural history, the study of the botany of an area never reaches finality. We hope that the Bookham Survey (already one of the longest surveys anywhere) will still be active in the year 2103.

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Appendix

Plant records accumulated in three surveys on Bookham Common

The first survey was in 1953, but it included a few notable earlier records. The second survey was from 1977 to 1979, and the third survey was from 1999 to 2002.

Legend

1 Recorded in first survey only.
2 Recorded in second survey only.
3 Recorded in third survey only.
12 Recorded in first and second surveys.
13 Recorded in first and third surveys.
23 Recorded in second and third surveys.
Recorded in all surveys.

Abbreviations

amyg amygdaloides; angust angustifolia; basford Basfordiana; Beth Bethlehem; brd broad; br bur; c common; d daisy; damas damasonium; ericet ericetorum; eve. evening; f-m-n forget-me-not; fr't'd fruited; g'f't goosefoot; gr'n green; g't'r greater; h'ndst. houndstongue; h'th heath; hy hybrid; int intermediate; lept leptoclados; l'ge large; l'vd leaved; mac maculatum; Ms Miss; m'w'd mayweed; nar narrow; p pondweed; p'rl pearl-proc procumbent; rob robbiae; sc'l'ss scentless; s'dd seeded; sl slender; s'n southern; Sol's Solomon's; sp'dw'll speedwell; sq square; St-J-w St. John's wort; st'k'd stalked; subs subspecies; thr'd thread; w water; wh white; w'herb willowherb; w'-m water-milfoil.

Division	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Acer campestre field maple	#	#	23	#	#	#			23	#	#	#	3	23	#	23	23	#	#	23
Acer platanoides Norway maple				#	23			3						23					23	3
Acer pseudoplatanus sycamore	#	#	#	#	#	#	#	23	23	23	3	23	23	3	3	3	23	#	#	23
Achillea millefolium yarrow	1		1	#	#				1		1		#	12	#	#	#	12	12	23
Achillea ptarmica sneezewort	1			1	13	3	1		1				12	#	#	#	#	#	12	#
Adoxa moschatellina moschatel	13	23	3																	
Aegopodium podagraria ground elder			#	23	23				23	#			#	#	12	23	#	#	#	3
Aesculus hippocastanum horse chestnut	23	#	#	23	#				3	2			23				23	#	23	#
Aethusa cynapium fools parsley			3														1		2	
Agrimonia eupatoria common agrimony	3			#	3		1			2	1		3	#	#	#	#	#	#	#
Agrimonia procera fragrant agrimony	#			23	3	3							#	#	#	#	23	#	23	3
Agrimonia × *wirtgenii* hybrid agrimony																				3
Agrostis canina velvet bent	13	#	12	#	#	#	#			12	3	3	#	#	12	13	#	#	#	#
Agrostis capillaris common bent	3	3	3	#	23	3	#	23	#	#	#	#	#	23	23	#	#	#	#	#
Agrostis gigantea black bent		3		3		3									2			13		
Agrostis stolonifera creeping bent	3	3	13	3	#	3	3	3	23	3	13	3	#	#	#	23	23	#	#	3
Aira caryophyllea silver hair grass				1																
Aira praecox early hair grass				1																
Ajuga reptans bugle	#	#	#	#	#	23	#	#	#	#	#	#	#	#	3	#	3	#	#	#
Akebia quinata five-leaved akebia					3															
Alisma plantago-aquatica w. plantain	13	1	12	13	1	1		1			1			#	#	1	13	13	1	1
Alliaria petiolata garlic mustard			23	#					23	#			#	23	13	#	#	#	#	#
Allium ursinum ramsons																			23	
Allium vineale wild onion																	2			
Alnus glutinosa alder														23			3	23	3	
Alopecurus aequalis orange foxtail														2						
Alopecurus geniculatus marsh foxtail	1			3	23	3							3	12	2	12		12		
Alopecurus myosuroides black grass					1															
Alopecurus pratensis meadow foxtail	12		1	13	#	13			12		13		#	#	#	#	#	#	#	
Anacamptis pyramidalis pyramidal orchid																			3	
Anagallis arvensis scarlet pimpernel			3	1						#			1		1		1	1		
Anagallis minima chaffweed																			1	

Division	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Anemone nemorosa wood anemone	13	13							23	13							23		3	
Angelica sylvestris wild angelica	13	3	1	#	#	23		1	23		3		23	#	#	#	#	#	#	#
Anisantha sterilis barren brome	1		1	13	#					13			#	13	#	#	#	#	#	
Anthoxanthum odoratum sweet vernal grass	#	3	#	#	#	#	#	13	#	23	#	23	23	#	#	#	13	#	#	#
Anthriscus sylvestris cow parsley		1	23	3	3				3	#			#	13	13	13	#	#	#	3
Apera spica-venti loose silky bent													1							
Aphanes arvensis parsley piert				1					1				1			1			12	
Aphanes inexspectata sl.parsley piert				2							1				3			2		
Apium inundatum lesser marshwort													1	#			1			
Apium nodiflorum fools watercress	1	1	13										1	#	#	#	#	#	3	
Aquilegia vulgaris columbine				2						13				1	3				1	
Arabidopsis thaliana thale cress											3					23		12	1	
Arctium lappa greater burdock	3	3	3	#	3	3		3	1	3	3		3	13	#	23	23	23	3	3
Arctium minus lesser burdock	3	3	23	#	1					13	3		#	3	#	3	3	#	23	3
Arenaria serpyllifolia ssp. *lept* sandwort						3														
Armoracia rusticana horse radish															3					
Arrhenatherum elatius false oat-grass	#	23	#	13	#	#	#	#	#	#	3	#	3	#	#	#	#	#	23	3
Artemisia vulgaris mugwort										3			3	12	3		2	#	#	23
Arum italicum Italian lords and ladies																		3		
Arum maculatum lords and ladies	#	23	23	#	23		3		#	#	#	3	23	#	23	23	#	#	#	23
Asparagus officinalis asparagus															12					
Aster lanceolatus nar.lvd Michaelmas d.																	1			
Aster novi-belgii confused Michaelmas d.																		2		
Aster × *salignus* common Michaelmas d.									3				3	3				3		
Athyrium filix-femina lady fern	23	3	2				23	23			#		3	3	3			23	3	3
Atriplex patula common orache			3							13			2		1		2			
Atriplex prostrata spear-leaved orache			3		1			2		1		2	1	2	13	1	#	3		
Ballota nigra black horehound																	2			
Barbarea vulgaris common wintercress				23										2	#	13	13	#	3	2
Bellis perennis daisy				#					3	#			#	#	13	#		#	1	1
Beta vulgaris beet														1						
Betula pendula silver birch	#	#	#	#	#	#	#	#	#	#	#	#	#	#	23	23	#	#	#	#
Betula × *aurata* hybrid birch	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Bidens cernua nodding bur-marigold			12	1	1					1			1	12	1	1		1		
Bidens tripartita trifid bur-marigold														#	1	1				2
Brachypodium pinnatum tor grass				1																
Brachypodium sylvaticum false brome	#	#	#	#	#	13	#	#	#	#	#	#	#	#	23	23	#	#	#	#
Brassica nigra black mustard																		3		
Briza media quaking grass													1			1	1		1	
Bromopsis erecta upright brome																		1		
Bromopsis ramosa hairy brome	#	23	#	#	#	13	3	3	#	#	#	#	23	23		23	3	#	23	3
Bromus commutatus meadow brome															13			3		
Bromus hordeaceus soft brome				3	13								#	#		3		#	1	
Bryonia dioica white bryony	12			13	1					1					#	#	#	#	12	12
Buddleja davidii butterfly bush															3				3	
Calendula officinalis pot marigold					1															
Callitriche brutia pedunculate w.starwort																	3			
Callitriche hamulata int. w.starwort	2													23			2			
Callitriche stagnalis common w. starwort	#	#	#	23	#	#	#	#	23	#	23	23	#	#	#	#	#	3	3	#
Caltha palustris cv.kingcup														3						
Calluna vulgaris heather				1									1	1					13	#
Calystegia pulchra hairy bindweed			2																	
Calystegia sepium hedge bindweed			3	13	1					3		23	#	13	#	#	#	#	#	
Calystegia silvatica large bindweed			23							1										
Calystegia × *lucana* hybrid bindweed										3										
Campanula persicifolia peach-lvd bellflower										3										
Campanula rotundifolia harebell				12							1		2	1	#	1	1	1	12	1
Capsella bursa-pastoris shepherds purse			3	1	#					23			12		#		13	13		
Cardamine flexuosa wavy bittercress	23	3	23	#	23	23	3	3	13	13	#	3	23	23	3	23	3	23	23	#
Cardamine hirsuta hairy bittercress			2	3	3	3		3		23	3		23	23			23	#	#	3
Cardamine pratensis cuckoo-flower	#	13	3	13	#	2			3		12		12	#	3	#	#	#	#	#
Carex caryophyllea spring sedge													1							
Carex divulsa grey sedge					3										2			2		
Carex flacca glaucous sedge				13	#	13	1				#	3	1	13	#	13	#	#	13	1
Carex hirta hairy sedge	12		3	#	#	#	1		#	3	3	#	#	#	#	#	#	#	#	#
Carex nigra common sedge	1			13	23									13	2	3	#	2		1

Division	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Carex otrubae false fox sedge	1	23	3	3	#	3							3	#	#	#	#	#	#	12
Carex ovalis oval sedge	13		23	#	#	#	2	13	1				3	#	#	#	#	#	#	#
Carex panicea carnation sedge														23	3	3	3		13	12
Carex pendula pendulous sedge	3	3	23	23		3			3	3	3	3		23	3	3	3	#	3	23
Carex pilulifera pill sedge	2		3												3		3		23	#
Carex remota remote sedge	#	#	23	13	3	3	3	3	3	23	13	3	23	#	3	13	13	13	3	23
Carex spicata spiked sedge					2									2		13		23		
Carex strigosa thin spiked wood sedge	23													3						
Carex sylvatica wood sedge	#	#	23	3	3	23	#	23	#	#	#	#	23	23	3	3	3	3	#	3
Carex viridula oedocarpa yellow sedge		1			3		1							23			13		13	13
Carpinus betulus hornbeam	#	#	3	#	#	23	23		3	3	23	23	13	3			3		23	3
Castanea sativa sweet chestnut	#	23	2						23	#		23	3		3		23		3	3
Centaurea nigra common knapweed	1		1	13	#	3			1		#		#	12	#	#	#	#	#	#
Centaurium erythraea common centaury				1									1		1	3		2		
Cephalanthera damasonium wh.helleborine																				2
Cerastium fontanum common mouse-ear	#	3	#	#	#	3	13	#	#	#	3	3	#	#	#	#	13	#	#	#
Cerastium glomeratum sticky mouse-ear	12		13	#	#	3	3	1	1	23			2	#	#	3	3	#		
Ceratophyllum demersum rigid hornwort													2							
Chaenorhinum minus small toadflax														1						
Chaerophyllum temulum rough chervil																	1			
Chamerion angustifolium rosebay w'hrb	12	#	12	12	#	#	#	12	12	12	#	12	#	#	12	#	23	23	#	#
Chelidonium majus greater celandine				3						2						3	3			
Chenopodium album fat hen					3					1			1		23		1			
Chenopodium polyspermum many sdd g'ft			3	1	#					2		2	2		#	3	13			
Chenopodium rubrum red goosefoot	1													1	12	1				
Chionodoxa luciliae glory of the snow			3																	
Chrysanthemum segetum corn marigold															3					
Circaea lutetiana enchanters nightshade	#	#	#	#	#	#	23	#	#	#	#	23	#	#	3	3	23	23	#	#
Cirsium arvense creeping thistle	3	3	13	#	#	3	3		23	#	3		#	#	#	#	#	#	#	#
Cirsium dissectum meadow thistle													1						1	12
Cirsium palustre marsh thistle	13	13	13	#	#	#	13	13	#	#	#	#	#	#	#	#	#	#	#	#
Cirsium vulgare spear thistle	13	3	3	#	23			3	1	3			12	12	#	#	13	#	#	#
Clematis vitalba travellers joy												3					3	1		
Clinopodium vulgare wild basil																		12		
Conium maculatum hemlock								2						3	#	#	#	#		
Conopodium majus pignut			2				13			1			23	1			#		2	12
Convolvulus arvensis field bindweed													3	2		3		#		
Conyza canadensis Canadian fleabane							3	2	2		2							3	3	
Conyza sumatrensis Guernsey fleabane																			3	
Cornus sanguinea dogwood	#	2	13	#	#	23	#	#	#	#	#	#	#	#	23	3	#	#	#	#
Coronopus didymus lesser swine-cress			3	13	3					3			1		3			3		
Coronopus squamatus swine-cress			3												#		1			
Corylus avellana hazel	#	#	#	#	#	#	#	#	#	#	#	#	#	#	23	23	#	23	#	#
Cotoneaster rehderi bullate cotoneaster																			3	
Cotoneaster simonsii Himalayan cotoneaster													3	13						3
Crassula helmsii New Zealand pygmyweed													3	3						
Crataegus laevigata Midland hawthorn	2				3	23	3	23	3	23	#	23	#	13		3	3	3	3	3
Crataegus monogyna hawthorn	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#
Crataegus persimilis br'd l'vd cockspur thorn																				23
Crataegus × macrocarpa hybrid hawthorn						3	3	3			3			3		2				
Crepis capillaris smooth hawksbeard			3	3	3	3		23	1	2	23	3	23	3	3	3	23	#	#	
Crepis vesicaria beaked hawksbeard				3															3	3
Crocosmia crocosmiiflora montbretia			3						3	3			3							
Cruciata laevipes crosswort																		2		
Cyclamen hederifolium cyclamen													3							
Cymbalaria muralis ivy-leaved toadflax													1							
Cynoglossum germanicum gr'n houndstongue				3																
Cynosurus cristatus crested dogs tail				#	1					2		1	12	1	1	1	1	1	1	1
Cytisus scoparius broom													1	13		3				
Dactylis glomerata cocks-foot grass	13	3	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#
Dactylorhiza fuchsii c. spotted orchid	1		2	1								3	12	#	3	1	1	#	23	
Dactylorhiza mac.ericet. hth.spotted orchid																				#
Dactylorhiza praetermissa sn.marsh orchid																		23	3	
Dactylorhiza × grandis hybrid marsh orchid																		3	3	
Danthonia decumbens heath grass				13	13	1		1	12	2					2		12	1	12	12
Deschampsia cespitosa tufted hair-grass	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#

Division	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Deschampsia flexuosa wavy hair-grass							12					3		3						13
Digitalis purpurea foxglove	#	#	#	#	13	13	13	#	23	#	1		3	#	3		3		3	#
Dipsacus fullonum teasel	2	3		3	3						3			2	#	#	23	#	3	2
Doronicum pardalianches leopards bane													2							
Dryopteris affinis scaly male fern	23			3				3	3			3	23						3	3
Dryopteris carthusiana nar.buckler fern	23	#	#	#	3	23	#	23	23	3	23	23	3	23	2		23		23	3
Dryopteris dilatata broad buckler fern	#	#	#	#	#	#	#	#	23	23	#	#	23	23	23	23	23	23	23	#
Dryopteris filix-mas male fern	#	#	#	#	#	23	23	#	#	#	#	#	#	#	23	23	#	#	#	#
Eleocharis palustris common spike rush														1		1	1			
Eleogiton fluitans floating club rush		1																		
Elodea canadensis Canadian waterweed			2										3	2						
Elymus caninus bearded couch	3	#								#			3						3	
Elytrigia repens couch grass		3	2	3	#	3				3			#		23	23	23	#	23	3
Epilobium ciliatum American willowherb				3	3	2	3	2	2	23	23	23	23	#	23	23	23	23	23	23
Epilobium hirsutum hairy willowherb	3	#	3	#	#	23	3	13	12	#	23		#	#	#	#	#	#	#	#
Epilobium montanum br'd l'vd w'herb	#	3	23	#	#	3	2	23	#	#	#	1	#	#	3	23	3	#	#	#
Epilobium obscurum short fr'td w'herb	#	#	3	3	3	23	1	2		1	12	3	13	12	23	12	13	1	#	3
Epilobium palustre marsh willowherb	1		1					2					1	1	2		#	13	23	
Epilobium parviflorum hoary willowherb	3	3	3		3	3		2		3	2			#	3	3	3	3	3	
Epilobium roseum pale willowherb										3										
Epilobium tetragonum sq. st'lkd w'herb	2	3	3									3		3	3	3	3	3	3	
Epilobium parviflorumxciliatum hybrid w'herb		3																		
Epipactis helleborine br'd helleborine				3														12	2	2
Epipactis purpurata violet helleborine										1										
Equisetum arvense field horsetail		1		#		3				1	3		13	#	#		#	#	#	#
Equisetum fluviatile water horsetail														12						
Equisetum palustre marsh horsetail														#						
Erica cinerea bell heather															2					2
Erica tetralix cross-leaved heath				2																
Erophila verna common whitlow grass																		1		
Erysimum cheiranthoides treacle mustard													1					1		
Erysimum cheiri wallflower																	1			
Euonymus europaeus spindle	#	23	12	23	#					12					#	#	23	#	23	23
Eupatorium cannabinum hemp agrimony		3												3						
Euphorbia amygdaloides wood spurge																			#	3
Euphorbia amyg.robbiae ms.robbs bonnet										23										
Euphorbia lathyris caper spurge										3										
Euphorbia peplus petty spurge			2	13	3					23			12	#	3		1	1	12	
Euphrasia anglica eyebright				1											2					
Euphrasia nemorosa eyebright				1									1	1					1	1
Fagus sylvatica beech	#	#	#	#	#	23	12	#	23	#	23	23	#		#		#	3	#	#
Fallopia convolvulus black bindweed													1				1			
Fallopia japonica Japanese knotweed										#										
Festuca arundinacea tall fescue									1		1		23	3				12	1	
Festuca gigantea giant fescue	#	#	23	#		#	3	3	3	23	3	3	23	3	2		3	3	23	23
Festuca ovina hirtula sheep's fescue																		3	23	3
Festuca ovina ovina sheep's fescue	1			1									1						2	1
Festuca rubra red fescue			1	#	#	23	2		13	2	3		#	#	12	#	23	#	#	#
Filipendula ulmaria meadowsweet	#		1	13		3								#	#	#	#	#		
Forsythia suspensa forsythia													3							
Fragaria vesca wild strawberry		1		12		1	1	#	13	#	12	12	12	#	13	1	1	1	13	12
Fragaria × ananassa garden strawberry										13										
Frangula alnus alder buckthorn	1									1			1		3					#
Fraxinus excelsior ash	#	#	#	#	#	#	#	#	#	#	23	#	23	#	#	#	#	#	23	23
Fritillaria meleagris fritillary										3										
Fumaria officinalis common fumitory										1										
Galanthus nivalis snowdrop				3									3			3	2			
Galega officinalis goats rue					3															
Galeopsis bifida bifid hemp nettle															3		3			
Galeopsis tetrahit common hemp nettle		3	3	3		3				#			1		12	2	23	12		
Galinsoga parviflora gallant soldier													1							
Galium aparine cleavers	#	#	#	#	#	#	3	13	#	#	23	23	#	#	#	#	#	#	#	#
Galium mollugo hedge bedstraw														1				1		1
Galium odoratum woodruff										2										
Galium palustre marsh bedstraw	#		3	13			1						#	#		#	#	23	#	13
Galium saxatile heath bedstraw	#	1	13	#	#	23	1	23	3		12	2	#	#	#	#	#	#	#	#

Division	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Galium uliginosum fen bedstraw	3		1	3	#	#		12	12		12		#	#	#	#	#	#	#	#
Galium verum lady's bedstraw															1	12		#		
Genista anglica petty whin				12	1	1							1		1	1	1		1	12
Geranium dissectum cut l'vd cranesbill			3	3	#		3		1	3	3		#	#	#	#	#	#	13	
Geranium ibericum Caucasian cranesbill																	1			
Geranium lucidum shining cranesbill										23										
Geranium molle doves-foot cranesbill					3	3											1	13		
Geranium pratense meadow cranesbill																		#		
Geranium pyrenaicum hedge cranesbill																		#		
Geranium robertianum herb robert	#	#	#	13	13	3	#	#	#	#	#	13	#	#	3	3	#	#	#	#
Geum urbanum wood avens	#	#	#	#	#	#	13	23	23	#	#	23	#	#	#	23	#	#	#	#
Glechoma hederacea ground ivy	#	#	#	#	#	13	13	3	#	#	23	3	#	#	#	#	#	#	#	#
Glyceria declinata small sweet-grass	23	23	12	3	3	3	3	3	23	3	23	3		3			3	3		
Glyceria fluitans floating sweet-grass	3	3	3	3	3	3		3	23	3		3	23	3		3	3	3	3	
Glyceria maxima reed sweet-grass																3		3		
Glyceria notata plicate sweet-grass														3	1	1				
Gnaphalium sylvaticum heath cudweed				1																
Gnaphalium uliginosum marsh cudweed	#	3	#	#	#	23	#	1	#	3	#	23	#	23	#	#	3	#	#	13
Hedera helix ivy	#	#	#	#	#	#	#	#	#	#	#	#	#	#	23	#	#	#	#	#
Hedera helix 'Hibernica' Irish ivy									3	3										
Helianthus tuberosus artichoke																	1			
Hemerocallis fulva day lily																2	1			
Heracleum mantegazzianum giant hogweed				3		3								3			3		3	
Heracleum sphondylium hogweed	#	12	#	#	13				13	#	3		#	#	#	#	#	#	#	#
Hesperis matronalis dames violet															23	#	23	23		
Hieracium sect sabauda hawkweed		2							1	12										3
Hieracium sect umbellata hawkweed									1	12			2	3	1				2	23
Holcus lanatus Yorkshire fog	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#
Holcus mollis creeping soft grass	3	23	23	3			3			2	3	3	2	2	3				2	23
Hordeum murinum wall barley				12						1			2		1	1	3	23		
Hordeum secalinum meadow barley					#								2		12	1	2	#	1	
Humulus lupulus hop			1	#	3	3								13	#	3		#	2	
Hyacinthoides nonscripta bluebell	#	#	#	#	#	#	#	3	3	#	3	3	3	3	23	23	#	#	3	#
Hyacinthoides xmassartiana hy.bluebell									3	3							3			
Hydrocotyle vulgaris marsh pennywort		1											12	13		1	13		#	#
Hyoscyamus niger henbane															1				1	
Hypericum androsaemum tutsan								3		1								2		
Hypericum calycinum rose of Sharon									1											
Hypericum hirsutum hairy St J wort	1													1		3		3	1	
Hypericum humifusum trailing St J wort	1	13	3	1	#	13	12	#	12	1	2	3	12	12	23	23	3		#	1
Hypericum perforatum perforate St J wort	12												2	1			3	#		
Hypericum pulchrum slender St J wort	1	13		#	3	3	23	23	2	1	#	3	13	#		1	23	23	#	#
Hypericum tetrapterum sq.stlkd St J wort	#			2										13	#	13	#	#	13	2
Hypochaeris radicata cats ear		1	#	#		3			12	12	#	3	#	#	#	23	13	#	#	#
Ilex aquifolium holly	#	#	#	#	#	#	#	#	#	#	#	#	#	#	23	23	#	23	#	#
Ilex aquifolium × *I.* × *altaclerensis* hy.holly				3			3			3										
Impatiens glandulifera Himalayan balsam			23	3						3					23	23	23	23	3	
Impatiens parviflora small balsam			3	3					3											
Inula conyzae ploughman's spikenard															1					
Iris foetidissima stinking iris													3			3		23		
Iris pseudacorus yellow iris			3							13	3		3	#	#	#	#	23	23	
Isolepis setacea bristle club-rush						3							3	23			23	3		13
Juncus acutiflorus sharp flowered rush							3							3			3			
Juncus articulatus jointed rush	3	1		1										#			23		3	12
Juncus bufonius toad rush	13	#	#	#	#	#	13	#	#	#	#	3	23	#	#	23	#	3	#	#
Juncus bulbosus bulbous rush		1	3											23				3	3	#
Juncus conglomeratus compact rush	#	3	3	#	#	13	3	#	#	#	3	#	23	13	#	#	#	#	#	#
Juncus effusus soft rush	#	#	#	#	#	#	#	#	#	#	23	#	#	#	#	#	#	#	#	#
Juncus inflexus hard rush	13		3	#	#	3	13	3	1	13	3		#	#	#	#	#	#	#	#
Juncus tenuis slender rush	13		3					3	3		3	3	3	23	3	3	3	23	13	3
Juncus × *surrejanus* hybrid rush					3	3									3		3	3	3	3
Koeleria macrantha crested hair-grass											1				1	1	1			
Lactuca sativa garden lettuce										1										
Lactuca serriola prickly lettuce						3										1				3
Lactuca virosa great lettuce				3																
Lagarosiphon major curly waterweed													2	2						

Division	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Lamiastrum galeobdolon archangel		3								3					3					
Lamium album white dead nettle	1		3		#				3	#			23	#	#	#	#	#	#	
Lamium maculatum spotted dead nettle													2			3	2	2		
Lamium purpureum red dead nettle					3				2	13			23	12	13	13	#	#	2	
Lapsana communis nipplewort	3	#	#	13	13	3	23	3	23	#	#	3	#	#	23	#	#	#	#	3
Lathyrus linifolius bitter vetch						1		1		12	13								12	12
Lathyrus nissolia grass vetchling				1											12	1		#	1	
Lathyrus pratensis meadow vetchling	1			13	#	3					3		3	23	#	#	#	#	#	#
Lemna gibba fat duckweed			3																	
Lemna minor common duckweed	13	1	#								1		#	#		1	#			
Lemna minuta least duckweed	3		3										3	3						
Lemna trisulca ivy leaved duckweed			1											#		1	13			
Leontodon autumnalis autumn hawkbit	13	3		#	3						3		#	13	23	23	23	23	3	13
Leontodon hispidus hairy hawkbit				1					1		1			1	1			12		
Leucanthemella serotina autumn ox-eye																	1			
Leucanthemum vulgare ox-eye daisy					13				1		1		2	#	1	1	13	#	3	
Leucojum aestivum summer snowflake			3														23		3	
Ligustrum ovalifolium Japanese privet	2		2							#			3		23			3		
Ligustrum vulgare common privet	#	12		1		3				1					#			23		3
Linaria purpurea purple toadflax															3					
Linaria vulgaris common toadflax																1			3	
Listera ovata twayblade																	1	1	13	#
Lithospermum officinale c.gromwell					1															
Lobelia erinus annual lobelia															3					
Lolium multiflorum Italian rye grass		1	1						2							1				
Lolium perenne rye grass	13	23	#	#	13	3	1		23	23	3	3	#	#	#	#	#	#	#	3
Lonicera japonica Japanese honeysuckle				3						3				3						
Lonicera nitida Wilson's honeysuckle									3	3				3						
Lonicera periclymenum honeysuckle	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#
Lotus corniculatus birds-foot trefoil	1		1	#	13	3			1	2	12		12	12	#	#	#	#	12	12
Lotus pedunculatus gtr birds-foot trefoil	3	1	13	#	#	13	13	3	3	23	#	#	#	#	#	#	#	#	#	12
Lunaria annua honesty													3				1		2	
Luzula campestris field woodrush	#	1	2		3	2		2	13	13	#	3	#	#	#	3	#	13	#	#
Luzula forsteri southern woodrush		2											2							2
Luzula multiflora heath woodrush	2		2										23				23	3	3	23
Luzula pilosa hairy woodrush			3					2	2	12			12							
Lychnis coronaria rose campion													2							
Lychnis flos-cuculi ragged robin	#	2		1										#	#	1	13	#	#	1
Lycopersicum esculentum tomato													1							
Lycopus europaeus gypsywort	#	1	#	3	3	3	3	1			23		23	#	#	#	#	3	23	#
Lysimachia nemorum yellow pimpernel	#	#	23	13			13	#	#	#	12	3	3	23		23	3		1	#
Lysimachia nummularia creeping jenny		13	1	3	1		3		13	13			#	#	#	#	13	#	13	2
Lysimachia punctata dotted loosestrife										3			1					23		
Lythrum portula water purslane	13	1	1	3	#	3	#		12				23	#	23	#	3	3	2	
Mahonia aquifolium Oregon grape																		2		
Malus domestica garden apple					3										3	3	3	3	3	3
Malus sylvestris crab apple	3	#	12	#	#	23	23	23	#	#	#	#	#	#	3	3	23	#	#	#
Malva moschata musk mallow																			1	
Malva neglecta dwarf mallow			3												1		1			
Malva sylvestris common mallow			3																	
Matricaria discoidea pineapple weed			12		#					13			#	13	12	1	12	13		
Matricaria recutita scented mayweed					1										1					
Medicago lupulina black medick															3	1	3	1	1	
Melica uniflora wood melic	1	#						3	3		3		3						3	3
Melissa officinalis balm					3					1					3					
Mentha aquatica water mint	3		13	3	3					1			3	#	#	#	#	#	#	12
Mentha arvensis corn mint	3			23						1			#	12	#	#	#	#	3	12
Mentha longifolia horse mint																	1			
Mentha pulegium pennyroyal																	1			
Mentha spicata spearmint			2																	
Mentha × *smithiana* hybrid mint										3										
Mentha × *verticillata* hybrid mint	1			3	3									13		1	3	3		1
Mentha × *villosa* var. *alopec.* hybrid mint															3					
Mercurialis annua annual mercury					1															
Mercurialis perennis dogs mercury	#	13	3	#	13														3	
Milium effusum wood millet				3	3															

Division	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Mimulus guttatus monkey flower																	3	3	3	
Moehringia trinervia 3-nerved sandwort	#	#	#	#	#	23	23	23	#	#	#	23	#	#	23	23	#	23	#	#
Molinia caerulea purple moor grass				1								1	#	3			13	1	#	#
Montia fontana blinks										3					2		1	2		
Mycelis muralis wall lettuce				1						3		3		23					3	3
Myosotis arvensis field forget-me-not	1			1	3	3				3			23	3	#	#	13	#	3	
Myosotis discolor changing f-m-n															23	2	13	12	1	
Myosotis laxa tufted forget-me-not	#			3										#	23	23	#	#	3	
Myosotis scorpioides water f-m-n			1	3	2									#	#	13	#	3		
Myosotis secunda creeping f-m-n														1		13				
Myosotis sylvatica wood forget-me-not				3	3					3			3	13	3	23	13	13	3	
Myosoton aquaticum water chickweed			23										3		2					
Myriophyllum alterniflorum alternate w-m				1																
Myriophyllum spicatum spiked w-m														23						
Nardus stricta mat grass																				12
Nymphaea alba white water-lily														1						
Odontites verna red bartsia			3	3	#	3					3		#	13	#	#	#	#	13	13
Oenanthe crocatahemlock w.dropwort			1												23		13	3		
Oenanthe fistulosa tubular w.dropwort																1				
Oenothera glazioviana large eve-primrose										1										
Ophioglossum vulgatum adders-tongue														3	3	12	#	#	12	
Ornithogalum angustifolium star-of-Beth.																		2		
Ornithopus perpusillus common birds-foot									1											
Oxalis acetosella wood sorrel	#	#	#	#	#	#	#	#	#	#	#	3	#	#						#
Oxalis articulata pink sorrel										2										
Oxalis europaea upright yellow sorrel										1										
Papaver rhoeas common poppy					1								1		1			1		
Papaver somniferum opium poppy										1			1		3		1			
Parthenocissus tricuspidata Boston ivy																	1			
Pastinaca sativa wild parsnip				3	3								#	1	#	13	13	#	#	#
Pedicularis sylvatica lousewort									1				1		2					
Pentaglottis sempervirens green alkanet			3	3						#				3						
Persicaria hydropiper water pepper	#	#	#	#	#	3	#	#	#	#	23	3	#	#	#	#	3	#	3	3
Persicaria lapathifolia pale persicaria									2					2	12					
Persicaria maculosa redshank		1	3	1	13	2			2				12	12	#	#	#	3	23	
Phalaris arundinacea reed canary grass				2	1								1	1	#					
Philadelphus virginalis mock orange										12										
Phleum bertolonii smaller cats-tail				#	1				1	2	13	3	#	1	13			1	12	
Phleum pratense timothy																		1	1	1
Phyllitis scolopendrium harts tongue	2														3		3	2		
Picris echioides bristly ox-tongue		3			3										3	3		3		
Pilosella officinarum mouse-ear hawkweed				12			1		1	1	12	1	1	1	12	1		1	1	1
Pimpinella saxifraga burnet saxifrage				12											2	1	1	1	1	
Pinus sylvestris Scots pine															#				23	
Plantago lanceolata ribwort plantain	1		13	#	#	3	3			23	13	3	#	#	13	13	#	#	#	13
Plantago major greater plantain	13	23	#	#	#	3	#	#	#	#	3	3	#	#	#	#	#	#	#	#
Poa annua annual meadow grass	#	#	#	#	#	23	#	23	#	#	#	#	#	#	#	#	#	#	#	#
Poa compressa flattened meadow grass															2					
Poa nemoralis wood meadow grass	3	#	#	12					3	13		13		23			2	2		
Poa pratensis smooth meadow grass	1			3					1		13			1			#	#	12	12
Poa trivialis rough meadow grass	#	3	#	#	#	13			3	3	#	12	23	#	#	#	#	#	23	23
Polygala vulgaris common milkwort				12	1								1							
Polygonatum × *hybridum* hy Sol's seal																			3	
Polygonum arenastrum equal knotgrass					3	3					3	3	3	3	3	3		3		
Polygonum aviculare knotgrass		3	13	13	#					#	3		#	3	#	13	12	#	3	3
Polypodium vulgare common polypody																3		3		
Polystichum aculeatum hard shield fern	3																			
Polystichum setiferum soft shield fern		1	2	13					3	3				23				23		
Populus alba white poplar																3		#		
Populus tremula aspen	#	23	3	23	#	#	#	23	#	#	3	3	#	#	3	3	23	3	#	#
Potamogeton berchtoldii small p														3						
Potamogeton crispus curled p		1												1						
Potamogeton natans broad-lvd p	13		12	1									23	12			13			
Potamogeton obtusifolius blunt-lvd p														2						
Potamogeton pusillus lesser p														2						
Potentilla anglica trailing tormentil	2	1	1		12	2					12			1		#			1	12

Division	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Potentilla anserina silverweed	12	1		#	23	13	13	1	13	1	13	1	#	#	#	#	#	#	#	
#*Potentilla erecta* tormentil	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#
Potentilla reptans cinquefoil	13		3	#	#	13	12	12	2	#	#		#	#	#	#	#	#	#	#
Potentilla sterilis barren strawberry	#	#	23	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	23
Potentilla × *mixta* hybrid cinquefoil				3	3	3								3						
Primula veris cowslip		12			1						3			3		1		12		
Primula vulgaris primrose	#	#	#	#	#	13	#	13	#	#	#	#	3	#	23		1	#		
Primula × *polyantha* hybrid primula											3									
Prunella vulgaris self heal	#	#	#	#	#	#	#	#	#	#	23	23	#	#	#	#	13	#	#	#
Prunus avium cherry			2	23				#	#	23	3	3	3	3					3	3
Prunus cerasifera cherry plum										3		3	3	3					3	
Prunus domestica plum	3				23									3	3	23	2	12		3
Prunus domestica ssp. *insititia* bullace															23	3		3		
Prunus laurocerasus cherry laurel							2	23	3	23			23	3					23	
Prunus lusitanica Portugal laurel									3											
Prunus serotina rum cherry			3																	
Prunus spinosa blackthorn				3					3					3	3					
Prunus × *fruticans* hybrid blackthorn				3	3	3		3			3	3	3	3	3	3	3	3	3	
Pteridium aquilinum bracken	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#
Pulicaria dysenterica fleabane	3	3	3	13	3	3	3			13			#	#	#	#	#	#	#	#
Pulmonaria mollis a lungwort				3																
Pulmonaria officinalis lungwort										3				2				3		
Pyrus communis pear				3												23	23	23	23	
Quercus cerris Turkey oak	#	#	#	#	#	#	#	#	#	23	23	23	#	23	23	3	3	23	23	23
Quercus robur pedunculate oak	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#
Quercus × *rosacea* hybrid oak											3						3			
Ranunculus acris meadow buttercup	12			13	#	1			12	#			#	13	#	#	13	#	#	#
Ranunculus bulbosus bulbous buttercup			1	2							1		12					1	1	
Ranunculus ficaria lesser celandine	#	#	3	#	#	13	3	3	#	#	#	13	#	#	#	#	#	#	#	#
Ranunculus flammula lesser spearwort	#	13	#	13	#	#	#	13	#	#	#	#	#	#	#	#	#	13	#	#
Ranunculus hederaceus ivy lvd crowfoot														1						
Ranunculus lingua greater spearwort														3						
Ranunculus peltatus pond water crowfoot	1		3										13	#		1	13			
Ranunculus repens creeping buttercup	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#
Ranunculus sceleratus celery-lvd buttercup	1		12											23	12					
Ranunculus trichophyllus thrd-lvd buttercup														2						
Raphanus raphanistrum radish					1															
Rhamnus catharticus common buckthorn															3		23	23	23	23
Rhododendron ponticum rhododendron									3	3										
Ribes nigrum black currant	3		1		1					#		13	#	#			23	#	3	3
Ribes rubrum red currant	#	23	23	23	13	23	3	3	3	#	#	23	#	#	2		#	#	#	#
Ribes uva-crispa gooseberry			1	2	3				3	3			3					#	2	12
Rorippa amphibia greater yellow cress														2						
Rorippa microphylla narrow watercress														12						
Rorippa nasturtium-aquaticum watercress														2		3				
Rorippa palustris marsh yellow cress															1	1				
Rosa arvensis field rose	3	23		3	#	#	23	3	23	#	23	#	23	#	#	23	23	#	3	#
Rosa canina dog rose	3			23	#	#		#	13	#	3	3	3	3	#	23	23	#	23	23
Rosa micrantha small sweetbriar					3						3			3						
Rosa multiflora many-flowered rose																			3	
Rosa obtusifolia round-leaved rose											3								3	
Rosa rubiginosa sweetbrier					1															
Rosa rugosa Japanese rose																	2			
Rosa × *andegavensis* hybrid rose					3						3									
Rosa × *pseudorusticana* hybrid rose									3											
Rumex acetosa common sorrel	1	1	1	#	#	#		12	12	#	#	12	#	#	#	#	#	#	#	#
Rumex acetosella sheep's sorrel				1			1				1		1		#				12	#
Rumex conglomeratus clustered dock	#		3	13	#		#	1	#	3			3	#	#	#	#	#	#	12
Rumex crispus curled dock				13	3								#		2	#		#	3	
Rumex obtusifolius broad-leaved dock	13	1	#	#	13	3	3			#	3	3	#	#	#	#	#	#	#	#
Rumex sanguineus wood dock	#	13	#	13	#	13	#	13	#	#	13	13	#	#	#	3	3	#	#	#
Rumex × *dufftii* hybrid dock		3						3					3							
Rumex × *pratensis* hybrid dock					3											3		3	3	
Ruscus aculeatus butcher's broom	#	#	#	#	#	#	#	#	#	#	#	#	#	#		2	#		#	#
Sagina procumbens procumbent p'rl-wort				12		3			1	12			12	2			1		1	1
Salix aurita eared willow						23													2	

Division	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Salix caprea goat willow	#	#	#	#	3	3	#	#	#	#	23	#	#	#	3	3	23	#	#	#
Salix cinerea grey willow	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	
#*Salix fragilis* crack willow	#	2		1	#									#		#	#	#	#	
Salix viminalis osier															#		23	#		
Salix × *multinervis* hybrid willow					3	3										3	3		3	3
Salix × *reichardtii* hybrid willow													3							3
Salix × *rubens* hybrid willow														3						
Salix × *rubens* 'Basfordiana' hybrid willow														3			3	3	3	
Sambucus nigra elderberry	#	#	#	#	#	#	3	#	#	#	23	#	23	#	#	#	#	#	#	#
Sanicula europaea sanicle		23	23	3	#		#	23	#	12	#	#	#	23					3	23
Saponaria officinalis soapwort																	2			
Saxifraga × *urbium* London pride									3	3										
Scilla siberica Siberian squill																		2		
Scrophularia auriculata water figwort	#		3	#	3				13	3			3	#	#	#	#	#	#	13
Scrophularia nodosa common figwort	#	23	#	#	12	23		3	3	12	12		3	3	2	3	3	#	#	#
Scutellaria galericulata skullcap														#						
Scutellaria minor lesser skullcap	#	#				#	12	#	2		#		2	1						13
Sedum album white stonecrop															3					
Sedum spurium Caucasian stonecrop															3					
Senecio erucifolius hoary ragwort	3		3	#	3	3			12	1	3	3	#	#	#	#	#	#	#	
Senecio jacobaea common ragwort		3	3	13		3	3		#	1			3	#	#	#	#	#	#	#
Senecio squalidus Oxford ragwort			2							2							1			
Senecio sylvaticus heath groundsel			3	23	23			2	2				1	1	23	23				1
Senecio viscosus sticky groundsel																23				1
Senecio vulgaris groundsel		3	3		3		1		2	2		2	12	#	12	2	#	1	3	
Senecio × *albescens* hybrid ragwort															3					
Serratula tinctoria saw-wort						1													2	
Silaum silaus pepper saxifrage				1	13	3								1	12	#	#	#	12	2
Silene dioica red campion	13	23	23							3			3			2			1	
Silene latifolia white campion													1					12		
Silene vulgaris bladder campion			1													1				
Sinapis arvensis charlock				1	1								1		1					
Sisymbrium officinale hedge mustard				12	3					3			13		1		23	#	3	
Solanum dulcamara bittersweet	13	12	#	#	#				13	13	#		#	#	#	#	#	#	#	13
Solanum nigrum black nightshade			3	1	13	2	2						1		2		3		13	
Solanum tuberosum potato										2							1			
Solidago canadensis Canadian golden-rod					1					1			1		3		1	1		
Solidago gigantea early golden-rod																		3		
Sonchus arvensis field sow-thistle			3	23						13	3	3	1	12	#		1	#	#	12
Sonchus asper prickly sow-thistle		3	3	13	#				2	1	3		1	3	#	13	#	#	3	3
Sonchus oleraceus smooth sow-thistle			3	1	3	3	3	2	2	#	2			12	23		2			
Sorbus aria whitebeam													2							#
Sorbus aucuparia rowan		13		3	3	23	#	23	23	23	23	#	23	#					3	#
Sparganium emersum unbranched br-reed														1						
Sparganium erectum branched br-reed	3												13	#		1	13		3	
Spergula arvensis corn spurrey															1					
Spiraea salicifolia bridewort														1				2		
Spiraea pseudosalicifolia hy.bridewort													3							
Spirodela polyrhiza greater duckweed			13										2	23						
Stachys officinalis betony	1			13	2	12	1	12	12	12	#	12		#	12	1	1	1	23	#
Stachys palustris marsh woundwort														#	#	#	#	#		
Stachys sylvatica hedge woundwort	#	#	#	#	13	13			3	#	#	3	#	#	#	#	#	#	#	#
Stachys × *ambigua* hybrid woundwort	3													3	1					
Stellaria graminea lesser stitchwort	#	2	#	#	#	3	#	1	12	23	#	#	#	#	#	#	#	#	#	#
Stellaria holostea greater stitchwort	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#
Stellaria media chickweed	13	13	23	#	#	#	3	3	23	#	3		#	#	#	3	#	#	23	#
Stellaria uliginosa bog stitchwort	23	#	#	3	23	3	#	3	3	#			#	#	3	3	3	3	3	3
Succisa pratensis devil's bit				#	#	13	12	1	12	12			#	12	#		#	13	#	#
Symphoricarpos albus snowberry									3	3							23	1		3
Symphoricarpos × *chenaultii* hy.snowberry										3										
Symphytum officinale common comfrey				3	#									3		#	3		23	
Symphytum orientale white comfrey																		2		
Symphytumxuplandicum Russian comfrey				3	#									3		13				
Tamus communis black bryony	13	#	#	#	#	12	#	1	1	#	#	#	#	#	#	#	#	#	23	#
Tanacetum parthenium feverfew										3			12							
Tanacetum vulgare tansy										1			23	#						

Division	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Taraxacum officinale dandelion	13	12	#	3	#	23	13	1	#	#	#	13	#	#	#	#	#	#	#	#
Taraxacum sec. *erythrosperma* dandelion															2					1
Taxus baccata yew	3	#	#			23	13	12	23	#	13	#	#	23				3	#	13
Tellima grandiflora fringe-cups										3										
Teucrium scorodonia wood sage			2	1				1	1				13							
Thymus pulegioides large thyme				1											1	1		1	1	
Tilia platyphyllos large-leaved lime				2							3								23	23
Tilia × *vulgaris* hybrid lime				1																
Torilis japonica hedge parsley	3	3	3	#	13	3			1	13	3	3	#	#	#	#	#	#	12	#
Tragopogon pratensis goatsbeard					1								3	12	1			12	1	
Trifolium dubium lesser trefoil			13	#			1		1		1		1	3	3	13		#	1	1
Trifolium fragiferum strawberry clover														1						1
Trifolium medium zigzag clover				12													1			1
Trifolium micranthum slender trefoil						3			1									13		
Trifolium pratense red clover	3		1	13	#	3	3		1	1	3	3	#	#	#	#	#	#	#	
Trifolium repens white clover	13	3	13	#	#	3	13		#	#	3	3	#	#	#	#	#	#	#	#
Tripleurospermum inodorum sc'lss m'wd				1	13					12			13		13	1	2	1		
Trisetum flavescens yellow oat-grass				1	1						1		2	1		1		1	1	
Tropaeolum majus nasturtium										1										
Tussilago farfara coltsfoot					1				1		3		13	3	3	23	#	12	#	13
Typha latifolia bulrush	3			1										#			1			
Ulex europaeus common gorse				#	1			2	23	1	23		#	#	12	1	#	#	12	2
Ulex minor dwarf gorse			3	#	13	13		1				1	12	13	12	#	#	1	12	12
Ulmus glabra wych elm															3		2			
Ulmus procera English elm	#	#		#	13									1	#	#	#	#	3	
Urtica dioica stinging nettle	#	#	#	#	#	3	3	3	#	#	23	3	#	#	#	#	#	#	#	#
Urtica urens small nettle													1				1			
Valeriana officinalis common valerian						3								1	#	2	3	23		
Verbascum thapsus great mullein													1	1				3		
Verbena officinalis vervain					12									2				3	1	
Veronica agrestis green field speedwell													1	1	3		1			
Veronica arvensis wall speedwell										3			23	13	#	13	3	1	1	1
Veronica beccabunga brooklime		1	1						3	1				#	1	3	3	#	3	
Veronica chamaedrys germander sp'dw'll	#	23	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#
Veronica filiformis slender speedwell			3			3				#			23	2	23		1	3		
Veronica hederifolia ivy-lvd speedwell			12	2	3					3			3	3	3		23	3	23	3
Veronica longifolia garden speedwell																	1			
Veronica montana wood speedwell	23	#	23	13	3	3	3		13	#			3		3		3	3	3	23
Veronica officinalis heath speedwell	1			#	13	2		23	12	12		2	12	23	#	13	3	1	13	
Veronica persica c.field speedwell			3	13	3					13			13	2	13					
Veronica scutellata marsh speedwell				3									3	12		3	13			1
Veronica serpyllifolia thyme-lvd speedwell	13	13	3	#	#	3	#	13	13	#	3	3	#	#	#	3	13	#	#	3
Viburnum lantana wayfaring tree															3					
Viburnum opulus guelder rose	#	3			3			1	23	3	23	23	13	23	23		23		23	23
Vicia cracca tufted vetch				#	#									13	#	#	#	#	2	
Vicia hirsuta hairy vetch					3								12	1	12	#	#	#	#	
Vicia sativa agg. common vetch				13	#				1	1			12		#	13	13	#	#	1
Vicia sepium bush vetch	1	12	1		#	23		1	13	#	13	1	#	#		13	23	1	3	
Vicia tetrasperma smooth tare				3	23	3			1					3	#	#	#	#	#	
Vinca major greater periwinkle			1												13			1		
Vinca minor lesser periwinkle				12	23				3	23			3							
Viola arvensis field pansy													1		3					
Viola canina heath dog-violet				1									1			1	23		1	1
Viola odorata sweet violet		2															3	#		
Viola reichenbachiana early dog-violet	#	#		3			3											3	3	
Viola riviniana common dog-violet	#	#	23	#	#	#	#	#	#	#	#	#	#	23	23	#	#	23	#	#
Viola × *wittrockiana* garden pansy															3					
Vulpia bromoides squirrel-tail fescue				12					1		1					1		1		

Book review

The changing wildlife of Great Britain and Ireland. Edited by David L. Hawksworth. Taylor & Francis and The Systematics Association. 2001. 454 pp. £165 (hardback) ISBN 0 7484 0957 2; £35 (paperback, 2003) ISBN 0415 32681 8.

This is but a bit of a book, and as such it is a real missed opportunity for biological science. What could have been one of the most important natural history books of 2001 turned out to be an expensive mistake.

In 1974 *The changing flora and fauna of Britain* was published. Also edited by Professor Hawksworth, it reported on the then recent changes to British wildlife, often brought about by human action. There has always been a fascination with the new — the newly arrived, the newly discovered, the newly invaded — and monitoring spread and change has been a major strength of the field naturalist, witnessing these changes as they occur. Recognizing the importance of a quarter-century gap, The Linnean Society of London sought to organize a two-day conference to re-examine the continuing changes at the cusp of the new millennium. But they failed to market the event and decided to cancel because of lack of interest. Instead, potential lecturers were invited to contribute a chapter to a book — the proceedings of a conference that never was. This fact is never, as far as I can discern, ever admitted in the present book.

The book duly appeared and the chapters it includes are excellent. They make fascinating reading, they are beautifully produced and they intrigue with the potential of further work. Even now I look forward to the next study in 2026. But I am rather disappointed by the major gaps in this book. Although there are superb chapters on many groups, including among the invertebrates Diptera, Hemiptera, Lepidoptera, Orthoptera, Odonata and Mollusca, there are huge gaps. Where are the chapters on Coleoptera, Hymenoptera and Arachnida? These are three of the greatest orders of British invertebrates, but we will never know how they fared at the end of the twentieth century.

The publishers are more than partly to blame for these shortcomings. They failed to produce a decent species list, they failed to fill the important gaps mentioned above and they failed originally to formulate a reasonable cover price. At least now, with the paperback edition, it will be within the reach of more readers.

RICHARD A. JONES

Rubus on Bookham Common

KEN PAGE

10 Cannonside, Fetcham, Leatherhead, Surrey KT22 9LE

We think that this is the first time a comprehensive survey of *Rubus* has been attempted on the Common. A list of fifteen microspecies and one species recorded by W.C.R. Watson in 1945 appeared in the flora of the first major survey (Jones 1954). In 1974 another, shorter list was compiled by Alan Leslie, Lady Anne Brewis and Alan Newton. The first real attempt to relate species and microspecies to divisions was made by Veronica Pilcher, Alan Leslie and Ken Page in 1984. Those microspecies which we were unable to identify at this time were determined by Alan Newton. When field recording for the most recent main flora began four years ago it was decided that a comprehensive *Rubus* survey would run concurrently with it.

The *Rubus fruticosus* aggregate is made up largely of microspecies which are apomictic, i.e. reproducing without genetic interchange; the progeny being identical with the parent. Many hundreds of these have been identified in the British Isles: some are thought to have arisen in the Pleistocene era. We have discovered twenty-five on the Common. Some are local or regional, and one may be a Surrey endemic.

Apart from the twenty-five microspecies there are three outbreeding (sexual, diploid) species: *Rubus caesius* (5 divisions); *R. idaeus* (14 divisions); and *R. ulmifolius* (9 divisions). The hybrid between dewberry and raspberry, *R. caesius* × *R. idaeus* (*R.* × *pseudoidaeus)* was named by Alan Leslie in 1984.

Some of the microspecies are not uncommon here. *Rubus britannicus* is a regional endemic restricted to southern England, mainly low-growing with heart-shaped leaves reminiscent of *Tilia* foliage which makes it easy to identify. As Table 1 indicates it is known from fifteen divisions. *R. armipotens* is another endemic common in SE England. It has been observed in fifteen divisions. It is related to and similar to *R. ulmifolius,* a 'good' species. However the microspecies differs, having larger leaves and more compact inflorescences. Both have conspicuous white indumentum on the undersides of the leaves.

Rubus surrejanus is abundant in woodland areas but does not flower well in shade. Again it is an SE England endemic, and was named from a Surrey specimen. It belongs to a series that is significantly hairy, but can be separated from its near relatives by the short thick patent prickles. It has been found in fourteen divisions. One of its near relations is *R. vestitus,* which is densely hairy with slender declining prickles and an almost round terminal leaflet. Unlike many British brambles it is widespread throughout western and central Europe and is equally happy on chalk or clay soils. On the Common it is known from thirteen divisions.

Said to be abundant in the neighbourhood of London, *Rubus cissburiensis* is another regional endemic. It is also abundant at Bookham where it is found in fifteen divisions. Its green stem strikingly blotched with red is a good character to look for ; also the leaves have undersides covered in grey indumentum, not white as in some other microspecies.

Among the brambles that are less common here are two with similar characters. Both have red or pink styles, elongate inflorescences and grow mainly in woodland. The first is *Rubus insectifolius* which has many leaves deeply insected(incised) and green on both sides. It is widespread in Europe and in nine divisions here. The second is *R. moylei,* with leaves much less deeply toothed and with grey undersides. It is noted in twelve divisions here and is endemic in the south of England.

With very long green stems (particularly conspicuous in winter), *Rubus milfordensis* is rather scarce, seen in just seven divisions. Its 'apple-blossom' type of flowers with long stamens are most attractive.

An endemic restricted to southern England, *Rubus nemorosus* is one of the largest-flowered brambles and the pale mauve to white blooms can be up to 4 cm across. It is one of the first to flower, sometime in May, with repeat flowering in September and October. Its tolerance of wet conditions makes it an ideal Bookham plant and it has been found in five divisions. It is widespread in central and western Europe.

The shape of the leaves is a good guide to the next microspecies, *Rubus polyanthemus.* They are subtruncate at the apex with a distinct cusp (a unique leaf-ending among the brambles of the Common.) We have found it in seven divisions.

Confined to woodland is *Rubus flexuosus,* aptly named with its zig-zag stems and flower stalks. During the recent survey many new sites were recorded bringing the total to nine divisions. This microspecies is widespread in Britain and Europe. Also mostly in woodland is *R. subinermoides,* an endemic of southern England. It has an almost wilting appearance and yellowish-white flowers — perhaps an odd combination. The leaves are grey-felted beneath, with the terminal leaflet invariably much narrower than the rest. We have found it in eight divisions.

The vigorous shining red primocanes of *Rubus cardiophyllus* cannot be easily missed. Add to this the heart-shaped, very long-stalked terminal leaflets, plus the grey indumentum on the undersides of the leaves and identification is reasonably certain. It is common in England, Wales and NW Europe, and has been seen here in four divisions.

The following microspecies are known from three or fewer divisions. Most are nationally widespread. *Rubus echinatus* is glandular and prickly as the specific name implies and has terminal leaflets that are narrowly diamond-shaped. It has been seen in three divisions. *R. conspersus* is a regional endemic and was first seen in 1981 in the two adjacent divisions M and T. This microspecies belongs to a series characterized by all parts of the plants being distinctly pubescent or hairy. *R. conjungens* was identified by W.C.R. Watson in 1945. It is a widespread endemic and appears to thrive in wet, heavy soils but found here in only one division. The flower stalks of *R. rufescens* are covered with a myriad of beautifully coloured glands, best seen with the aid of a magnifying glass. With us it is a low-growing shrub with red-brown stems seen in two divisions.

Common in western Europe and late flowering with masses of very white flowers describes *Rubus lindleianus.* The purity of its flowers is striking, and we have it also in two divisions. *R. orbifolius* was first seen and named by David Allen on one of his visits to Bookham. Its only site is in division Q. The name does not yet appear to be authentically established.

During the latter part of the recent survey *Rubus euryanthemus* was discovered in division T. The flower stalks are interlacing and very glandular. The plant is frequent in NW Europe. We have one record for *R. platyacanthus,* in division D. It has high arching green or brown stems and numerous strong straight prickles. The plant is also frequent in NW Europe. The well-known garden bramble *R. laciniatus,* easily identified by its deeply cut foliage has been seen once, in division M.

Before coming to our rarities mention should be made to what must be the 'thug' among brambles. Although handsome in leaf, flower and fruit *Rubus armeniacus* 'Himalayan Giant' threatens to overwhelm the countryside with its size, vigour and its ability to self-sow. This European alien is present in seven divisions.

We have two — possibly three — national rarities at Bookham, according to the recent monograph *Brambles in the British Isles* by E.S. Edees and Alan Newton (1988). It states that *Rubus formidabilis* is restricted to Surrey (VC 17.) It is characterized by all parts of the flowers being pink. The petals are deep pink with the styles and filaments slightly paler. As the specific name implies, it is heavily armed. It grows in both woodland and more-open areas and we have it in seven divisions.

Almost as rare, it seems is *Rubus neomalacus* which has tentatively been recorded for N Hants (VC 12.) In Surrey it is reported from twenty-six localities (D.E. Allen), and at Bookham we have it in nine divisions, mostly on the edges of tracks,

usually as single plants. It is included in the series with highly whitened undersides to the leaves and in this plant the upper surfaces are hard, tough and deep green.

Rubus averyanus was reported from Bookham many years ago, though we have been unable to refind it However, there is a plus to this story. The M25 motorway runs through the *locus classicus* at Colley Hill, Surrey. *R. averyanus* has survived here and is regrowing on the northern embankment! This is a very distinctive microspecies with long-based narrow yellow prickles, backward pointing to lie almost parallel to the stem. It is a local endemic, reported from East Sussex(VC 14) and West Kent(VC 16.)

Acknowledgements

First, I would like to thank David Allen for finding time to visit us and for naming specimens. Thanks also to Bryan Radcliffe for the *Rubus* microspecies table and its frequent updating. Finally, thanks to my botanical colleagues for their patience and tolerance as we tramped the Common searching for new bramble records. They were, in alphabetical order: Elspeth and Roger Baxter, Keith Bosher, Peter Coxhead, Pat Jenkins, Sheena Paterson and Roy Sherlock.

References

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TABLE 1. *Rubus* microspecies at Bookham.

Division	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	div/sp
Rubus armipotens	R	X	R	R	R	R	R		G	R	G	G	G		X			G	R		15
R. armeniacus			R	G						R			G			R		G	R		7
R. britannicus	R	X	R	R	R	R	X		R	R			X	G	R	R			R	G	15
R. caesius	R				R								R	G				R			5
R. cardiophyllus	G		G	G														G			4
R. cissburyensis			G	G	G	G			G	G	G	G	G	G	G	G		G	R	R	15
R. conjungens													R								1
R. conspersus													X							X	2
R. echinatus					R									X	X						3
R. euryanthemus																				G	1
R. flexuosus	G		G	G		G		G				G	X			G				G	9
R. formidabilis					X	R							X	G				R	R	X	7
R. insectifolius		X	X	G	X					G				X	X	G			X		9
R. idaeus			X	X	R			G	X	X		R	R	R	X		X	R	R	R	14
R. laciniatus													X								1
R. lindleianus					X												R				2
R. milfordensis				G	G										G	G		G	R	G	7
R. moylei	G	G	G	G				G			G	G	R		G			G	X	R	12
R. neomalacus			G		G	G		G			G		G			G			R	G	9
R. nemorosus					R	R							X		X		R				5
R. orbifolius																	R				1
R. platyacanthus				R																	1
R. polyanthemus				R	G				G						G	G	R		G		7
R. × *pseudoidaeus*													G								1
R. rufescens										G			R								2
R. subinermoides		X	R	R				G		X	G			R					R		8
R. surrejanus	G	R	G		R	G	R	G	G		G				G	G	G	G	R		14
R. ulmifolius	R			G	R	G							G			X	R	R	R		9
R. vestitus		G	G	G	G	R		G	G	G			G	G				G	G	R	13
spp/div	8	7	13	15	16	10	3	7	7	9	6	5	18	9	11	10	7	12	15	11	199

X = Recorded prior to 3rd survey — 33 records
R = Recorded prior to and repeated in 3rd survey — 68 records
G = New record in 3rd survey — 98 records

Book reviews index

Hampstead Heath Survey

Progress Report for 2002

General (Colin Bowlt, Chairman, Hampstead Heath Survey)

One of the limitations to our survey of the Heath (as, of course, for any area) is the availability, or otherwise, of members with competence in identification. The flowering plants continue to be recorded on a 100-metre quadrat basis. When the data have been suitably computerized it is hoped to publish a new flora of the Heath. We are fortunate in having Mark Burgess working on algae, and some recording continues of the macrofungi. Of the invertebrates there has been little recording apart from ladybirds by Denzil Devos.

Considering the large number of bird-watchers there are in the Society it is somewhat surprising to find that there is apparently little recording of the bird life on the Heath. John Barrington has continued with his survey of the pond birds, but the annual *Hampstead Heath Bird Report*, started many years ago by Geoffrey Taylor, continued for decades by Kate Springett, and then most recently by Bill Oddie, has apparently ceased. This is a pity.

The wild service tree *Sorbus torminalis* (Jeremy Wright)

All wild service trees and saplings known on Hampstead Heath and Kenwood were inspected and surveyed in 2001. A short article, with a map of locations, results, data, analysis and discussion, was published within the Hampstead Heath Report in *The London Naturalist,* **80**, 2001. This showed that the Heath was fortunate in having nineteen mature trees, twelve naturally propagated saplings (of which nine are likely to be of seed origin) and one planted young tree.

Since then, five further saplings have been discovered. Because of interest in wild service as an indicator species of ancient woodland, their locations and details are now recorded in Table 1.

All these saplings are in secondary woodland and scrub, and are located on the Claygate Beds. They are 64 metres or less from the nearest mature tree, and are therefore all likely to have propagated as suckers.

TABLE 1. Survey data of wild service trees and saplings on Hampstead Heath and Kenwood. Additional records 2003.

Grid reference	Diameter, mm	Height, m	Distance, m	Features and comments
East Park				
2677 8663	110	4	64	6 m. W of giant oak
Cohen's Fields and Stock Pond				
2750 8717	60	5	45	In Stock Pond enclosure
2750 8717	20	3	45	In Stock Pond enclosure
2752 8717	90	7	57	In Stock Pond enclosure
2752 8717	5	1	57	In Stock Pond enclosure

Key to columns

Grid reference OS Grid to approx. 10 metres accuracy; **Diameter** (equivalent) in millimetres; **Height** approx. in metres; **Distance** in metres, of sapling from nearest mature tree.

Algae — old records from Hampstead Heath (Mark Burgess)

The historical dimension of the wildlife is important in trying to understand the ecology of an area. Unfortunately, historical data are usually in short supply, although the Heath is rather more fortunate with respect to flowering plants (see, for instance, Villiers and Bowlt 2001). It is therefore considered worth adding the following report of algae, found in the Hampstead Ponds in 1868 by members of the Quekett Microscopical Club (Anon. 1869, Braithwaite 1868), to the corpus of wildlife records being accumulated. The nomenclature has been updated.

APRIL 4, 1868. HAMPSTEAD PONDS.

Day mild, genial, and sunny.

Chlorophyta: Volvocales

Volvox globator L. (abundant)

Pandorina morum (Müller) Bory

Chlorophyta: Desmidiaceae

Micrasterias rotata (Greville) Ralfs

Euastrum oblongum (Greville) Ralfs

Closterium lunula (Müller) Nitzsch

Closterium turgidum Ehrenberg

Closterium striolatum Ehrenberg

Closterium acerosum (Schrank) Ehrenberg

Cosmarium margaritiferum (Lundell) Roy & Bisset

Chlorophyta: Coleochaetales

Coleochaete scutata de Brébisson

Dr. Ramsbotham sends us the following:
'A *Volvox globator* becoming partially entangled amongst some confervae, I had an opportunity of observing that which I had never seen before, viz., that the young organisms within the parent globe, on moving in various directions, propelled some of the minute green spots beyond the circumference of the sphere; they were again attracted and again repelled, when by an apparently stronger push one or two were entirely separated, and sent afloat, gradually disappearing from view.'

Mr. Ward remarks:
'One *Volvox* of about 1/40 in. diameter contained six smaller ones each about 1/160 in. There was an aperture in the parent cell-wall through which I saw four of the six escape in quick succession.

'Each one took some few seconds to get through, as the opening seemed exactly as large as the spheres, and as soon as the way was clear another presented itself at once. The two last, though revolving freely, never made an attempt to pass through whilst I watched them. A second *Volvox*, of larger size, but with smaller internal globes, contained a foreign body (from the outline I

thought a dead rotifer). With a high power I could distinctly focus front of cell-wall, then this body, and lastly back of cell. I could detect no aperture, however, in the cell.'

Remarks:

I have found *Volvox* in the Viaduct Pond (on 29 July 2001) but it is by no means common in Hampstead ponds. The rotifer that Mr Ward remarked was possibly *Notommata parasitica*, a parasite of *Volvox*. As in all records from such excursions, the species list is largely dictated by the equipment used and the favourite group(s) of the collector. For instance, the thirty people on this jaunt must have found many diatoms, but none is recorded.

Other organisms collected by the party included the protists *Actinophrys sol* Ehrenberg, *Stentor mulleri* (Bory St. Vincent, 1824) Ehrenberg, 1838, *Epistylis anastatica* Linnaeus, 1767 and *Carchesium polypinum* Linnaeus, 1758.

The members also collected four species of rotifers: *Conochilus hippocrepis* (Schrank, 1830) (abundant), *Rotaria rotatoria* (Pallas, 1766), *Floscularia ringens* (L., 1758) and *Collotheca ornata* Harring, 1913 (abundant).

Acknowledgements

I would like to thank Dr Colin Bowlt for his helpful comments on this note.

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Plant galls — a teach-in (Ken Hill)

On 30 June 2002, a group of people gathered at the Hampstead Heath Extension building for a meeting arranged by Colin Bowlt and the writer for the purpose of introducing anybody interested into the subject of plant galls. A brief reconnaissance had shown that there were a number of interesting galls on a wide variety of plants, and which would occupy a morning, hopefully of sufficient interest for those who turned up. In the event about fifteen came along and Colin gave them an introductory talk whilst awaiting the arrival of the writer, unfortunately delayed by transport problems.

The section of the Heath that was examined proved of interest to a number who stayed on for the field work, and showed that several people working over the same ground often find more examples than one person alone might do. Sharp eyes help! A list of the discoveries follows.

On blackthorn *Prunus spinosus* (L.), the mite *Eriophyes prunusspinosae* (Nalepa).

On aspen *Populus tremula* (L.), a depression probably caused by aphids, and not recognized as a true gall.

On willow *Salix alba* (L.), the leaf wasp *Pontana proxima* (Lepeletier), and also *Monostichella salicis*, the asexual generation of *Drepanopeziza salicis*, a causer of anthracnose, which was identified by Dr Brian Spooner of Kew.

On hawthorn *Crataegus monogyna* (Jacq.), the mite *Aceria crataegi* (Canestrini).

On whitebeam *Sorbus aria* (L.) (Crantz), the mite *Eriophyes arianus* (Canestrini).

On field maple *Acer campestre* (L.), the mites *Aceria macrochelus* (Nalepa) and *Aceria aceriscampestris* (Nalepa).

On scyamore *Acer pseudoplatanus* (L.), the mite *Aceria cephaloneus* (Nalepa).

On oak *Quercus robur* (L.), the wasp *Andricus aries* (Mayr.), the asexual generation, also known as the Ramshorn gall; the cynipid wasp *Neuroterus quercusbaccarum* (L.), the sexual generation, also known as the common spangle gall; the cynipid wasp *Cynips quercusfolii* (L.), known as the cherry gall, which was cut open at home to determine; the wasp *Andricus anthracina* (Curtis), the asexual generation known as the oyster gall; the wasp *Andricus lignicola* (Hartig), the asexual generation known as the cola nut gall; and the wasp *Andricus curvator* (Hartig), the sexual generation which causes a deformation of the twig.

On common lime *Tilia* × *europaea* (L.), the mites *Eriophyes tiliae* (Pagenstecher), known as the common nail gall, and *Eriophyes leiosoma* (Nalepa).

On stinging nettle *Urtica dioica* (L.), the fly *Dasineura urticae* (Perris).

On bramble *Rubus fruticosus* agg. (L.), the mites *Eriophyes rubicolens* (Canestrini) and *Phyllocoptes gracilis* (Nalepa).

On hazel *Corylus avellana* (L.), the mite *Phytoptus avellanae* (Nalepa) which causes big bud.

On ash *Fraxinus excelsior* (L.), the psyllid (jumping plant louse) *Psyllopsis fraxini* (L.).

It must be emphasized that lists are not exhaustive; there may be others present which have not been found at the time. When collecting specimens, a pair of pruners is a very useful tool as it prevents unnecessary damage to the more woody plants. It *is* necessary to name the host plant from which the specimen was taken. Gathered material does not always show sufficient detail for correct identification. Finally, please keep eyes alert and send in specimens.

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Botanical records for 2002

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Abstract

This paper presents a selection of records of interest made in the London Area in 2002, including new vice-county records of native species *Geranium purpureum* in West Kent, *Sagina maritima* in Middlesex and Surrey, *Dryopteris* × *deweveri* in Middlesex and *Apium repens* in Essex, and first British records of mostly casual aliens *Cuphea ignea* (Lythraceae) *Dryopteris cycadina, D. erythrosora, Erodium trifolium* and *Sutera cordata* (Scrophulariaceae).

Introduction

This annual series of papers presents a selection of the more significant vascular plant discoveries and rediscoveries of the preceding year made in the London Natural History Society's recording area, a circle of radius 20 miles (almost exactly 32 km) centred on St Paul's Cathedral in the City of London. For biological recording purposes, the British Isles are divided into 'vice-counties', areas of less unequal area than the counties of the time, invented by Watson (1873); the circle contains the whole of one of them, v.c. 21 (Middlesex), and parts of five others. In these papers, the records are presented in the numerical sequence of vice-counties, and within each vice-county records begin with those from places within the present boundaries of London, working from the more central boroughs outward, and then proceed to the outer parts of the circle.

The discovery of a new native flowering plant species in London is a rare event, but there were two such events in 2002, with the *Red Data Book* (Wigginton 1999) species creeping marshwort *Apium repens* occurring in Essex and sea pearlwort *Sagina maritima* in Kent, Surrey and Middlesex. Material of the former has been precisely matched with plants from the other previously known extant British population near Oxford, and the identity of specimens of the latter, which is to be the subject of a separate paper by its finder, relating it to salinity levels in the tidal Thames, was confirmed by the national referee for the genus Dr N. Jardine.

In 2002 records of black poplar *Populus nigra* subsp. *betulifolia* were collected as part of the biological action plan for that tree, but as a precaution most of them will not be mentioned here, because of the need for expert in-situ verification. Records of rue-leaved saxifrage *Saxifraga tridactylites* made early in the year were reported and mapped by Burton (2002).

V.C. 16, West Kent

In West Kent, *Sagina maritima* is not a new species for the vice-county as it is in Surrey and Middlesex, but it is a rare or overlooked one. I do not know of records later than those published by Philp (1982). The record from the square including Gravesend in Kent Preston et al. (2002) is from a site in Essex (K.J. Adams pers. comm.). The new record, by John Edgington like those from Surrey and Middlesex, was from a stretch of about 1,100 metres of the Thames embankment in North **Greenwich**. Prof. Edgington made many other interesting observations along this part of the tideway and downstream past the Millennium Dome. A planted reed-bed on a tidal platform at the site of Phoenix Wharf could be seen to be becoming colonized by English scurvy-grass *Cochlearia anglica*, and tidal mud at the end of Drawdock Road had sea arrow-grass *Triglochin maritima*. East of the Dome thrift *Armeria maritima* and sea campion *Silene uniflora*, which in other parts of Britain are attractive plants of coastal cliffs and shingle, were escaping from cultivation in gravelly flower-beds by the river walk. Further downriver is the Trust for Urban Ecology's Greenwich Peninsula Ecological Park, with a very curious collection of plants. The species

list in the form in which it came to me was accompanied by an observation commenting on the remarkably rich flora for such a site, but to my mind indicates only that a great variety of plants have been brought into cultivation here, and perhaps no proper record kept. Orange foxtail *Alopecurus aequalis*, lesser water-plantain *Baldellia ranunculoides*, nodding bur-marigold *Bidens cernua,* greater tussock-sedge *Carex paniculata*, cyperus sedge *C. pseudocyperus* and much else may contribute to the attractions of Greenwich, but have no connection with the vegetation at this place in any past age, or with urban ecology. The list purports to result from Brian Wurzell's survey of the site, but it does not mention the hybrid sedge *Carex acuta* × *C. acutiformis*, which he told me he found there. This is another new plant for Kent, but in its company must be treated as of doubtful status. In 1977 Mr Wurzell and I found brookweed *Samolus valerandi* in a ditch on what was then the Woolwich Arsenal site; I have looked for it there at infrequent intervals since then without success, but in 2002 it was found again in the same ditch, now in West Thamesmead, by Mark Spencer. This was communicated to me by Jon Riley, who himself found dittander *Lepidium latifolium* growing out of the Thames wall in Greenwich, the nationally scarce species clustered clover *Trifolium glomeratum* together with knotted clover *T. striatum* in the lawn in front of Charlton House and yellow bartsia *Parentucellia latifolia* in the same field at Pippenhall Farm where I did in 1990, thinking it then to be impermanent.

A small part of the borough of **Croydon** is in vice-county 16; the Kent / Surrey boundary crossed what is now South Norwood Country Park, but for convenience I have to assume that all records from this site belong in the Kent part. The Park was surveyed botanically in 2002 by Ron Parker, whose list includes marsh pennywort *Hydrocotyle vulgaris* (no doubt introduced), whereas the records John Bedford sent me include the invasive alien floating pennywort *H. ranunculoides* in one of the streams. No doubt both are present. In **Bromley**, I found about a thousand plants of little robin *Geranium purpureum* on the railway tracks at St Mary Cray station; this new plant for the vice-county is native on the south coast of England, but in this locality, as elsewhere in London, it must be regarded as a naturalized plant, where it occurs on railways probably introduced accidentally with the ballast for the track. Prof. Edgington has told me of an exactly similar occurrence of this species on the stations of Mannheim and Karlsruhe in Germany. According to the criteria of Baker (1955) the introduced plants in London should be referred to subsp. *purpureum*. Our records from **Bexley** in 2002 include Margot Godfrey's nettle-leaved goosefoot *Chenopodium murale* at the bare edge of the mown verge of Merewood Road, Barnehurst and a variety of plants from the Crayford area listed by John Palmer, of which I select for mention musk mallow *Malva moschata*, the alien 'subsp. *mauritiana*' of common mallow *M. sylvestris* and wild clary *Salvia verbenaca* at Barnes Cray, and a still unidentified *Linaria* sp. well established on roadside banks with dark green leaves, glandular inflorescence and crowded pale blue flowers.

Mr Palmer's records from the modern county of **Kent** in our area include many from earth banks thrown up along roadsides to prevent gypsy caravans from going onto the verges. Some plants may have come with the earth, the source of which cannot usually be traced, others by natural means. The problems caused by this doubt are well illustrated by the record of a strongly blackish-purple-tinged plant of cow parsley *Anthriscus sylvestris* on such a bank on Dartford Heath; there is a garden cultivar 'Ravenswing' of this species with this character, but it is impossible to tell whether the plant on the bank is of garden origin or not. A bank on Green Street Green near Dartford had wild clary *Salvia verbenaca* which is well known as a native plant of roadsides in this area, but also blue fleabane *Erigeron acer* and many different forms of wild pansy *Viola tricolor*. By the main road at Hawley the banks had tree mallow *Lavatera arborea* and reflexed saltmarsh-grass *Puccinellia distans*, and a bank east of Wood

Street had a melon plant *Cucumis melo*. Another odd assortment of mostly alien plants came from the green at Swanley Village, which had been resown; native species pale flax *Linum bienne*, musk mallow *Malva moschata* and large thyme *Thymus pulegioides* had certainly been sown with the grass, but what of bee orchid *Ophrys apifera*? And was the introduction of *Coreopsis lanceolata* L., *Gaillardia pulchella* Foug., large Venus's-looking-glass *Legousia speculum-veneris*, *Linum austriacum* L., *Ratibida columnaris* D. Don and sweet-William catchfly *Silene armeria*, inter alia, deliberate or accidental? Other records of Mr Palmer's selected for a mention are wall bedstraw *Galium parisiense* on a flint wall 'one-fifth of a mile from the main locality' at Farningham, important because later in 2002 the wall in front of the Manor House which is the main locality for this nationally scarce species had to be rebuilt, with the loss of all of its plants; Des Etangs' St-John's-wort *Hypericum* × *desetangsii* in Farningham Wood and nearby in Calfstock Lane; and the garden plant *Erodium trifolium* (Cav.) Guittonneau becoming an increasingly numerous weed at Sutton-at-Hone.

Mrs Godfrey also found *Chenopodium murale*, together with the even rarer stinking goosefoot *C. vulvaria*, on a disturbed verge in Joyce Green Lane. Other names familiar from past years are those of Joyce Pitt and Geoffrey Kitchener. Only Mrs Pitt has mentioned any possible effects of the crisis caused by the national epidemic of foot-and-mouth disease in 2001, suggesting a possible reduction in disturbance of habitats which were 'out of bounds' for much of that year. She reported having seen basal rosettes of greater butterfly-orchid *Platanthera chlorantha* in the spring of 2002 along the edge of Farningham Wood, but this was not substantiated by any sight of flowering plants later. Mr Kitchener found a scattering of about twenty plants of sea fern-grass *Catapodium marinum* along the verge of the A224 at Polhill, one of the less commonly observed coastal plants along salted roads. A name which has not been here for many years is that of Geoff Joyce; he found hundreds of pennyroyal *Mentha pulegium*, large white helleborine *Cephalanthera damasonium* and a single green-veined orchid *Orchis morio* at Bradbourne Lakes nature reserve near Sevenoaks, a bee orchid possibly referable to *Ophrys apifera* var. *belgarum* among the man orchids *Aceras anthropophorum* on the roadside nature reserve north of Shoreham station, and another variant bee orchid, this time with the lip reversed, at the usual Lullingstone Park site for lizard orchid *Himantoglossum hircinum*. Dr Joyce also told me of plants found by others: two more plants of lizard orchid on the facing slope, and one each of bee orchid and large white helleborine above Purgate Bottom in Farningham Wood found by Ray Froude, and annual yellow woundwort *Stachys annua* appearing after scrub clearance above Shoreham Ranges, found by Stan Perry.

V.C. 17, Surrey

Prof. Edgington's Surrey locality for *Sagina maritima* is Pageant Stairs by the Thames in Rotherhithe. Readers wishing to verify that the plant is still there are warned that great care is needed to reach it. Another **Southwark** record from the Society's secretary is of *Lepidium latifolium* choking an untended flower bed on Cherry Garden Pier, Bermondsey. In a similar habitat by HMS *Belfast*, Aaron Woods found both hairy tare *Vicia hirsuta* and smooth tare *V. tetrasperma*.

Ian Kitching found a large clump of Turkish iris *Iris orientalis* at the top of Little Tibbet on Putney Heath in **Wandsworth**; like the two patches of galingale *Cyperus longus* nearby, it might have been planted. Dr Kitching's records from his home borough of **Merton** are much more varied and interesting. Floating pennywort *Hydrocotyle ranunculoides*, previously in our records only from one stretch of the River Wandle, by the Wilderness Island Local Nature Reserve in Sutton, from which it was supposed to have been cleared in 2001 by the Environment Agency, is now present in many colonies from the Merton boundary down to Ravensbury Park, having increased greatly during 2002. On

the extreme western boundary of Merton, at the A298/A3 road junction, Dr Kitching found a small grassy area in which the most abundant plant was knotted bur-parsley *Torilis nodosa*, but the most remarkable was dwarf mouse-ear *Cerastium pumilum*, found for only the second time in the present London, and like the first time, on railway tracks near Mill Hill in 1951, not native; the well-known native locality on Banstead Downs, where it has perhaps not been seen since 1989, is just in the modern county of Surrey. Other plants in this grass included biting stonecrop *Sedum acre*, field madder *Sherardia arvensis* and slender trefoil *Trifolium micranthum*. *C. pumilum* needs careful examination to distinguish it from other small mouse-ears such as *C. semidecandrum*, which he collected at the base of a pavement tree in London Road, Morden, but I have seen supporting specimens of these two and the identification is undoubtedly correct. On a waste heap in the south-east corner of Morden Cemetery Dr Kitching found a small plant of castor-oil plant *Ricinus communis*. Near the cemetery in two ponds in a meadow by the Pyl Brook he found fringed water-lily *Nymphoides peltata*; this looked quite convincing, but I believe even the ponds are a recent creation. On tracks by the crossing at Phipps Bridge Tramlink station was a plant of the hybrid of great and dark mulleins, *Verbascum* × *semialbum*, with the commoner of its parents. From between the roots of a small fallen tree in Morden Park he collected *Astrantia major*; the specimen is fairly clearly referable to subsp. *carinthiaca*. A pathside *Bromus*, probably originally sown as it was on one of the artificial hills on Mitcham Common, was identified as meadow brome *B. commutatus* var. *commutatus* by reference to Spalton (2002). A grass from under the boundary fence of a car park in Church Road, Mitcham was identified by Dr Kitching as *Brachypodium pinnatum* in the strict sense. In Britain this name has been used for the native tor-grass, which has slightly glaucous leaves, very long spikelets which tend to curve outwards, and glabrous lemmas with short awns. The latter can be separated as *B. rupestre* (Host) Roemer & Schultes, leaving the name *B. pinnatum* free for plants with green leaves, straight spikelets and lemmas with hairs visible with sufficient magnification (at least × 15) and usually longer awns, which in Britain are perhaps absent from natural habitats.

From **Richmond upon Thames**, Tom Cope sent me lists of plants from the Royal Botanic Gardens, Kew, which by the time of publication should also be available on the Kew website. The list from the Thames path outside the gardens includes the British endemic bramble *Rubus moylei* and dense-flowered mullein *Verbascum densiflorum*. Neil Anderson reports about a square metre of small melilot *Melilotus indicus* by a path and greater herb-Robert introduced with soil to a 'sustainable garden', both at the Barn Elms Wetland Centre. George Hounsome found the increasing alien perfoliate alexanders *Smyrnium perfoliatum* on the Thames path west of Hammersmith Bridge, and Himalayan sorbaria *Sorbaria tomentosa* on a wall by the river at Kew.

Dr Kitching reported a number of casual plants from the sides of an unfinished road south of Ridge Road, North Cheam in **Sutton**. Rock crane's-bill *Geranium macrorrhizum*, shining crane's-bill *G. lucidum* and lesser meadow-rue *Thalictrum minus* presumably came originally from a garden somewhere, but what can have been the origin of round-leaved fluellen *Kickxia spuria* on top of waste soil heap, and the single plant of broad-leaved spurge *Euphorbia platyphyllos*? Still in North Cheam, he also found a clump of Neapolitan garlic *Allium neapolitanum* by the Pyl Brook, and by a recently disturbed roadside at the angle of Ampere Way and Beddington Farm Road he came across a single plant of rue *Ruta graveolens*. Ron Parker found oak-leaved goosefoot *Chenopodium glaucum* with other goosefoots on a roadside near IKEA in **Croydon**.

Chris Pogson was able to confirm Rob Woodall's record of a single plant of × *Dactylodenia st-quintinii*, the cross between fragrant orchid and common spotted

orchid, from downland at Pebble Coombe in **Surrey**. Steve Gale sent me useful counts of rarities in the Box Hill area: more than 150 scattered coralroot *Cardamine bulbifera*, only two musk orchid *Herminium monorchis*, but fifteen autumn lady's-tresses *Spiranthes spiralis*.

V.C. 18, South Essex

Prof. Edgington provided me with a number of records from the **Newham** side of the River Lea. Where the Northern Outfall Sewer Bank crosses Abbey Creek on Mill Meads, he found a badly misshapen male tree of black poplar heavily infested with a gall which gives a spiral twist to the petioles; this gall is frequently found on the black poplar, but never on the frequently planted hybrids, providing a useful identification tool. The combination of herbaceous plants in the same area, including cuckoo-flower *Cardamine pratensis*, large bird's-foot-trefoil *Lotus pedunculatus*, ragged Robin *Lychnis flos-cuculi* and fodder burnet *Sanguisorba minor* subsp. *muricata*, suggests to me that there has been an introduction of 'wild' flowers here. The last-named is an exotic which frequently gets supplied in such mixtures in lieu of the native salad burnet subsp. *minor*. In a new pond on the Bully Point nature reserve he found thread-leaved water-crowfoot *Ranunculus trichophyllus* and buttonweed *Cotula coronopifolia*, again indicators of deliberate introduction; this pond is exactly on the vice-county boundary, which here is slightly east of the borough boundary along the River Lea. The population of *Apium repens* referred to in the introduction was discovered by Brian Wurzell in almost inaccessible mud by a ditch on Walthamstow Marshes in **Waltham Forest**, suffering competition from jointed rush *Juncus articulatus* and overhanging brambles; the ditch had been cleaned out the year before as part of habitat maintenance and improvement works, and in early 2003 several hundred square metres adjacent to the *Apium* were cleared so that it should have space to spread. Near the *Apium* Mr Wurzell also found blunt-flowered rush *J. subnodulosus* and small sweet-grass *Glyceria declinata*, also new plants for that site. *Rorippa* × *armoracioides* has been christened Walthamstow yellow-cress because of its former abundance in the northern part of Walthamstow Reservoirs, though I was unable to refind it there a few years ago. A specimen collected in 2002 by Dr Kitching on a street corner in Upper Walthamstow is clearly referable to this hybrid, but I do not suppose that there is any connection with the Reservoirs population.

A survey of **Barking and Dagenham** was carried out for the Greater London Authority in 2002, as the basis for a revised list of sites of interest for nature conservation. Comparing it with the previous, published, list (Curson et al. 1992) there seems to have been only one discovery worth a mention here, marsh ragwort *Senecio aquaticus* near the Beam River south of the District Line crossing. For **Redbridge**, I had the plant list for Hainault Forest Country Park produced by Brian Ecott. It includes sea club-rush *Bolboschoenus maritimus* in Hainault Lake, lesser water-parsnip *Berula erecta* in the outflow from the lake, and wild celery *Apium graveolens* on a bank near the outflow. Mary Smith produced a list of plants omitted from the square TQ58, which is partly in **Havering** in the *New atlas of the British and Irish flora* (Preston et al. 2002). Remarkably, these include ivy-leaved toadflax *Cymbalaria muralis*, still present at the site where it was first introduced to Britain four hundred years ago. Mrs Smith found hairy whitlow-grass *Erophila majuscula* at three sites in the square, and knotted clover *Trifolium striatum* as a new species for Belhus Woods Country Park. Her list includes the seldom recorded hybrid rye-grass *Lolium* × *boucheanum*, found by Bob Creber. The remainder of the square is in **Essex**, here taken to include the Thurrock unitary authority. She found a remarkable site on highway land near the new A13 road near Aveley, which she surveyed with Jill Ireland in May. Its flora included lots of knotted clover, subterranean clover *T. subterraneum* and clustered clover *T. glomeratum*, a scattering of spring

vetch *Vicia lathyroides* and many other unusual plants. A new species for the Essex part of the Country Park was alder buckthorn *Frangula alnus*, but it was planted here, as it was in quantity on another site not far away in Thames Chase. Hainault Forest Country Park is also partly in Essex; Mr Ecott's list for this includes ivy-leaved crowfoot *Ranunculus hederaceus* at Roes Well and frogbit *Hydrocharis morsus-ranae* in the pond called Sheepwater, the latter at least surely introduced.

V.C. 19, North Essex

Another specimen I was pleased to see was Robin Blades' round-fruited rush *Juncus compressus*, collected on the Cornmill Stream nature reserve near Waltham Abbey, a new plant for this part of the Lea valley.

V.C. 20, Herts.

A small group of plants of the hybrid hogweed *Heracleum mantegazzianum* × *H. sphondylium* was found on our meeting of 14 April, near Darlands Lake nature reserve in **Barnet**, a site cut in two by the vice-county boundary. This seems to be a first record for the Herts. part of our area. In modern **Hertfordshire**, Peter Ellison found many plants of the variety of common broomrape *Orobanche minor* var. *compositarum* as a parasite on silver ragwort *Senecio cineraria* in Watford. I have seen a document in which Mr Wurzell claims to have found the hybrid sedge *Carex* × *subgracilis* as far north as Broxbourne, which would make it a new plant for Herts., but have no further details.

V.C. 21, Middlesex

Prof. Edgington found a crown of the East Asian fern *Dryopteris erythrosora* (D.C. Eaton) Kuntze in a disused churchyard off Cannon Street in the **City of London**; his identification was confirmed by Alison Paul at the Natural History Museum. This seems to be the first record of this plant out of cultivation in Britain. A somewhat less unfamiliar exotic fern *Adiantum raddianum* C. Presl came to his notice in basement areas in the **City of Westminster,** inside Burlington House, Piccadilly and in Glentworth Street. He found a one-metre tall plant of kangaroo-apple *Solanum laciniatum*, a new plant for the London Area (except that some time ago it used regularly to appear self-sown in the Chelsea Physic Garden), under a lamp-post in Richardson's Mews. In a lawn at the Jewel House in Westminster were *Hypericum humifusum* trailing St John's-wort and *Luzula multiflora* heath wood-rush, perhaps introduced in the turf. In Regent's Park he found dozens of patches of pennyroyal *Mentha pulegium*, a scarce native plant in other parts of Britain, by the lake between the bandstand and The Holme, and marjoram *Origanum vulgare* under trees nearby; untended scrub in the Bird Sanctuary had kidney vetch *Anthyllis vulneraria*, wild basil *Clinopodium vulgare* and larkspur *Consolida ajacis*. It is likely that all of these plants have been deliberately introduced to the Park. Aaron Woods' Westminster records include single plants of *Clarkia unguiculata* in a basement area in Conway Street, Danish scurvy-grass *Cochlearia danica* on a paved forecourt in Cleveland Street and *Leucanthemum paludosum* (Poiret) Bonnet & Barratte on a pavement in Fitzroy Street. A more significant discovery, made independently by Mr Wurzell early in 2003, was of a substantial population of London rocket *Sisymbrium irio* in Warren Street and Conway Street. Another pavement plant in Westminster, presumably from a hanging basket somewhere though the source was not visible, was Elizabeth Norman's *Sutera cordata* Kuntze in Weymouth Street. Mr Woods also found several plants of *Leucanthemum paludosum* on a pavement near his home in **Camden** Town, and in a similar place nearby self-sown *Cuphea ignea*, another first British record. In his own garden several plants of *Arachis hypogaea* came up where squirrels had buried peanuts! Prof. Edgington lives in the same borough, and near his home found another new

alien fern confirmed by Alison Paul, also from Japan and China, *Dryopteris cycadina* (Franch. & Sav.) C. Christ. Near the two parent species on Hampstead's East Heath, he found the hybrid of broad and narrow buckler-ferns, *D.* × *deweveri*, a new plant for the vice-county. George Hounsome reports a single plant of dragon arum *Dracunculus vulgaris* by a wall on Parliament Hill Fields, known for some years but previously sterile and unrecognized — there is no mistaking a fertile plant! Prof. Edgington found Mexican fleabane *Erigeron karvinskianus* on doorsteps and walls in two places in **Islington** and two in Westminster.

He also recorded plants from the **Tower Hamlets** side of the Lea. The Middlesex *Sagina maritima* is from Limehouse Hole Stairs, a very similar habitat to the Surrey one's, and at the entrance to Shadwell canal basin there was a large and distinctive colony of little-Robin *Geranium purpureum*. Several plants of musk stork's-bill *Erodium moschatum* were in the gravel of the canal path south of Mile End Road; as a native species, this is scarce, but in our area, where there are now at least six known populations, it is hardly native. Actually by the Lea towpath opposite Tesco's car park Prof. Edgington found four fruiting plants of keeled-fruited cornsalad *Valerianella carinata*. Mr Parker's 2002 records also included a few from this borough; Italian alder *Alnus cordata* was seen to be seeding itself in the East India Dock Basin, and in Mile End Park corn buttercup *Ranunculus arvensis* and hairy buttercup *R. sardous* were noted as 'brought in with soil?', but I think more likely brought in deliberately. Up-Lea in **Hackney**, Mr Wurzell's notes give tape-grass *Vallisneria spiralis* as occurring 'down to Clapton', making it a new plant for the borough, and Prof. Edgington, with John Swindells, found a large stand of ancient plants of fly honeysuckle *Lonicera xylosteum* on the Arena Field recreation ground, and a tall tree of cider gum *Eucalyptus gunnii* nearby right against the vice-county boundary. On Tottenham Marshes in **Haringey** Mr Wurzell found a population of *Galium parisiense* on somewhat trampled ground, not near the extant population in South Tottenham which he had discovered in 1984, and yet again *Carex* × *subgracilis*. In Queen's Wood David Bevan found twelve plants of broad-leaved helleborine *Epipactis helleborine* and one of thin-spiked wood-sedge *Carex strigosa*, its fourth London locality. Mark Spencer's discovery of the Japanese knotweed / Russian vine hybrid *Fallopia* × *conollyana* at the North Middlesex Sports Club, Crouch End, was reported by Bailey and Spencer (2003). Prof. Edgington found several plants of *Cyclamen hederifolium* under trees by the Turkey Brook in **Enfield**.

Leslie Williams told me that he and Simon Mercer had found smooth brome *Bromus racemosus* in six fields in Fryent Country Park in **Brent**, where it had perhaps been previously overlooked among meadow brome *B. commutatus*. He also passed on to me records by Sandra Cao of twayblade *Listera ovata* in her front lawn in Winston Avenue, Kingsbury, possibly introduced somehow in moss peat, and Roy Beddard of about a dozen plants of bee orchid near the new Cool Oak Lane car park in **Barnet**. John Dobson found water horsetail *Equisetum fluviatile* in Stanmore Marsh in **Harrow** where it had previously been seen on a Society field meeting in 1983, when we called the site Whitchurch Common.

Prof. Edgington's one **Kensington and Chelsea** record of interest is of a hawkweed *Hieracium vagum* in Brompton Cemetery. Dr Kitching's best in this borough is spotted medick *Medicago arabica* in a raised garden in Princes Gate. Mrs Norman had *Galium parisiense* in her own garden! Prof. Edgington also offered one record from **Hammersmith and Fulham**, a plant of rosemary *Rosmarinus officinalis* growing out of the embankment wall near Blakes Wharves. The records from **Hounslow** in 2002 are more numerous because of the attention paid to parts of Syon Park not normally accessible. The last records I have from the drier parts date from the 1950s, and it was pleasing for Mr Hounsome and me to be able to find in May along the long winding ha-ha upright brome *Bromopsis erecta*, meadow saxifrage *Saxifraga granulata*, *Trifolium striatum*,

T. subterraneum and dark mullein *Verbascum nigrum*. Many of these were seen again at our meeting of 27 June, but there was no sign of small-flowered wintercress *Barbarea stricta* which has perhaps now gone from London. Ann Rix told me of three new localities for bee orchid in **Hillingdon**: five plants on a verge in an industrial estate in Hayes found by herself, twenty-two found by Barry Nicholson in Ten Acre Wood and six scattered plants in Mabey's Meadow near the Colne found by Roger Taylor. Carol and Bill Hawkins, in their last year of residence in London, sent me records mostly from two sites. The grounds of the derelict house of Highgrove near Eastcote were known to botanists over twenty years ago, but are now called Highgrove Wood and are completely accessible. Among the now fully naturalized plants they found there, some with Mr Hounsome, the alien subspecies *pulchellum* of summer snowflake *Leucojum aestivum*, honey garlic *Nectaroscordum siculum* and Turkish squill *Scilla bithynica* are new taxa for the vice-county. The first Middlesex record of *Leucanthemum paludosum* was made early in the year at the Trout Lane dump at Yiewsley, which later was visited by our field meeting of 5 May. Other new Middlesex plants seen then were subsp. *characias* of Mediterranean spurge *Euphorbia characias* and Jerusalem sage *Phlomis fruticosa*. Bill and Carol also mentioned Chinese bramble *Rubus tricolor* 'taking over the car-park' by Springwell Lock, reported independently by Mr Ellison.

V.C. 24, Bucks.

Mr and Mrs Hawkins reported a large colony of Italian lords-and-ladies *Arum italicum* on the **Buckinghamshire** side of the Colne near Huntsmoor. This colony had previously been reported by Bill Langham in 1967, who referred it to the native subspecies *neglectum*. In the Hawkinses' interpretation, both subspecies are now present, together with intermediates. With Mr Hounsome, they visited Kingcup Meadow by the River Misbourne which I mentioned last year (Burton 2002: 226), adding blinks *Montia fontana* to its known flora.

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Obituary

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MAX NICHOLSON, CB, CVO, LL.D, MBOU, 1904–2003

The death of Max Nicholson on 26 April 2003, at the age of 98, has deprived the world of conservation of one of its greatest proponents and the London Natural History Society of one of its most illustrious honorary vice-presidents.

Edward Max Nicholson was born at Kilternan, County Dublin, on 12 July 1904. He became an ornithologist, and later a conservationist, and played an important part in almost every major development in those two fields in Britain during the twentieth century. The societies and other bodies which he launched, or helped to launch, included the British Trust for Ornithology, the Edward Grey Institute for Field Ornithology in Oxford, the International Union for Protection of Nature and the World Wildlife Fund. He was a skilled ornithologist and could recognize at once calls that would keep many modern birdwatchers guessing.

He started off by writing two books, one before he even went up to Hertford College, Oxford. These were *Birds in England* (1926) and *How Birds Live* (1927), not to mention a little orange pamphlet published by Benn that helped the present obituarist to become an ornithologist. These books, together with *The Art of Birdwatching* (1931), were important stimulants of the great surge in interest on birdwatchers and field ornithology that marked the 1930s.

Max himself was active from the 1920s onwards. In London he counted house sparrows in Kensington Gardens, and in 1925–6, with his brother Basil, carried out a complete winter bird census there, and he did so again, in 1975, this time with Roy Sanderson. He followed starling flylines from the tops of the then open-topped buses. At Oxford he helped to start bird-ringing on Christ Church Meadow, and launched the Oxford Bird Census in 1927, soon followed by the pioneer national breeding census of any bird, the grey heron, in 1928. This, coupled with the national census of great crested grebes run by Tom Harrisson and P.A.D. Hollom, led to the British Trust for Ornithology in 1933, which mobilized the growing band of birdwatchers to help with future national bird censuses and contribute to many more national surveys. Later in the decade his special interest in bird song and calls enabled him to write the text to accompany Ludwig Koch's pioneering discs, published as *Songs of Wild Birds* and *More Songs of Wild Birds*. Max also helped H. F. Witherby to produce the then standard work on British birds, *The Handbook of British Birds*.

The Second World War swept Max out of organized ornithology for a time, but after he had filled an important post in the Ministry of War Transport, under Sir Cyril (later Lord) Hurcomb, himself a keen birdwatcher, for several years, he emerged as one of our leading conservationists, working behind the scenes. In his post-war capacity as head of the office of the Lord President of the Council (Herbert Morrison), he was a member of the Advisory Council on Scientific Policy from 1948 to 1962. He also helped to set up, and was a member of, the Wildlife Conservation Special Committee, an official body under the chairmanship of first Julian Huxley and later Arthur Tansley, whose report led to the creation of the Nature Conservancy, ancestor of the present-day English Nature. Max was its second Director-General, from 1952 to 1966, and made it so effective in achieving wildlife conservation that after its battle with the Civil Service over the siting of the present Dungeness power station, that machine downgraded the Conservancy's powers so that it could not try to thwart the Civil Service again.

For many years Max served on Lord Hurcomb's Committee on Bird Sanctuaries in the Royal Parks which published regular reports on the birds and other wildlife. Many of the observers were members of the LNHS. Sadly, this committee was abolished in 1979. Max was instrumental in founding the William Curtis Ecological Park on a disused lorry park on the South Bank near Tower Bridge which flourished as a small nature reserve and educational facility for a number of years.

Under Civil Service rules Max was obliged to retire at the age of sixty, but this did not stop him continuing to be a top ornithologist and conservationist. He not only served a term as President of the Royal Society for the Protection of Birds, but helped in the editing both of the journal *British Birds* and of the monumental *Birds of the Western Palearctic*, the *Handbook*'s successor, where he wrote the sections on habitat and voice. He was also convenor of the conservation section of the International Biological Programme and was much involved with the 'Countryside in 1970' programme. His post-war books include *Birds and Men* in the New Naturalist series (1951), *Britain's Nature Reserves* (1958) and *The New Environmental Age* (1987). In the mid 1990s Max had one of his 'periodic clear-outs' and donated some of his papers to the LNHS. The result was that the Society was in 1995 able to publish *Bird-Watching in London — a historical perspective*. This book describes his intensive observations on the birds of Inner London between 1924 and 1926. The manuscript had lain unopened for sixty years and it was the privilege of the LNHS to bring both the observations and the methodology described in the book to a wider public. In 2002 the Society published *The breeding birds of the London Area* and Max contributed an introductory 'Historical Perspective'.

Max lived most of his life in London, initially in Westminster and then for some sixty years in Chelsea. He joined the London Natural History Society in 1934 and was made an honorary vice-president in 1964. It was to everyone's regret that his many commitments prevented him from becoming president, an honour which so many wished him to have. He was, however, always available for consultation and his advice was freely given and much to the point.

To celebrate Max's ninetieth birthday, a dinner was held at The Athenaeum on 12 July 1994 and many of those associated with the organizations he fathered or fostered over the years attended.

Max was so many-sided that an obituary of equal length could easily be written about his many achievements in the social sciences, notably the foundation of Political and Economic Planning (PEP) in 1931 and several post-war books, such as *The System: the misgovernment of Britain* (1967) on the shortcomings of the Civil Service. Max was secretary of the committee that ran the 1951 Festival of Britain, and he came up with the idea of the Silver Jubilee Walkway to celebrate the Queen's twenty-fifth year on the throne. We shall most certainly not see his like again.

RICHARD FITTER

The London Naturalist
Instructions to contributors

Submission of papers

Papers **must be submitted in duplicate** to the editor, Mr K. H. Hyatt at his home address, 1 Tremcelynog, Rhandirmwyn, Llandovery, Carmarthenshire SA20 0NU. Please contact the editor before the end of January if you wish to contribute to the forthcoming issue. However, the editor may be contacted at any time on 01550 760346 to discuss possible contributions, and will be pleased to send a recent offprint to show our style, and as a guide to preparing the manuscript. Manuscripts **must be double spaced throughout** on one side of the paper only and with wide (3-cm) margins. Authors must retain a copy. Papers should include at the beginning an **abstract, summary** or **synopsis. Sheets must be numbered.** Papers are peer-reviewed as appropriate. After acceptance, the editor would be pleased to receive contributions as ASCII files on disc in IBM-compatible format. Papers should be relevant to the natural history and archaeology of the London Area. This includes comparisons between London and its surrounding countryside with other localities, as well as work relating to or comparing species or habitats which occur in the London Area. Contributions of relevance nationally will also be considered.

Text

Locality spellings should follow the latest editions of maps published by the Ordnance Survey. Capitalization should be kept to a minimum. Common names of animals and plants must begin with lower-case initials (except for proper nouns), and **only** Latin names of genera and species must be underlined unless typed in italic. When both common and Latin names are given there should be no brackets or commas separating them. **Genus names should appear in full where first used within each paragraph.** When scientific names are taken from a standard work, which must be cited, authorities should be omitted. In descriptive matter numbers up to a hundred should be in words, except in a strictly numerical context. Dates should follow the logical sequence of day, month, year, i.e., 25 December 1971, but in lists may be as 25.xii.1971. Measurements should be in metric and follow the SI system (Système International d'Unités), with imperial equivalents in parentheses where appropriate. There should be no full point following Dr, Mr, Mrs, or St. Lists should be in systematic, alphabetic or numerical order. **Hyphens should not appear at the ends of lines** as the right-hand margins of manuscripts do not need to be justified: **turn off the hyphenation option. Tables and figure legends should be typed on separate sheets at the end of the text. Word-processed text should not use italic, bold or compressed typeface. Paragraphs should be indented. Sentences must not begin with numerals.**

References

Reference citation should be based on the Madison rules (*Bull. Torrey bot. Club* **22:** 130–132 (1895)), except that a colon should always precede a page number. Capitalization in titles of books and papers in journals should be kept to a minimum. Journal titles should be in full, or follow the abbreviations in the *World list of scientific periodicals,* and be underlined or in italics. Book titles should also be underlined or in italics.

Examples are as follows:

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Meadows (1970: 80) or (Meadows 1970).

In references:

MEADOWS, B. S. 1970. Observations on the return of fishes to a polluted tributary of the River Thames 1964–9. *Lond. Nat.* **49:** 76–81.

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Distribution maps should be submitted in the form of a recording map with symbols in Indian ink and stencilled or by transfers, e.g., 'Letraset'. Solid dots are used to indicate contemporary or recent presence, circles for old records, and crosses (not pluses) for other information, such as introduced species. The caption should be written outside the frame of the map and will be set up by the printer. Scale bars must be included within the frame of the map.

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